U.S. BARLEY INDUSTRY

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ABSTRACT

Economic, physical, and institutional forces have brought changes in barley supply, demand, and prices. The importance of barley as a feed grain is declining in the United States while increasing elsewhere. If current trends continue, barley will be produced in the United States primarily for malting purposes within the next decade. As this change occurs, barley production will require new policy considerations. This report examines underlying economic forces and associated changes in the barley industry; quantifies barley and barley products flow from the producer to the consumer; describes industry organization and practices; and shows trends in world trade.

Key words: Feed barley, Malt barley, Subsector analysis, Barley marketing

On January 1, 1978, three USDA agencies--the Economic Research Service, the Statistical Reporting Service, and the Farmer Cooperative Service--merged into a new organization, the Economics, Statistics, and Cooperatives Service.

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CONTENTS

HIGHLIGHTS

Barley's use as a livestock feed is declining, but the American appetite for beer is maintaining the grain's position as a major crop in this country.

The major domestic use for the grain is as livestock and poultry feed. However, this use has declined in recent years in favor of other feed grains, dropping from 254 million bushels in 1960 to 190 million bushels in 1975. In contrast, the production of malting barley--the major grain used in making alcoholic beverages--increased from 82 million to 127 million bushels in the same period. This reflects an increase in beer sold by the Nation's brewers from 84 million to 150 million barrels in the past 25 years.

Barley planted in 1977 increased by 1.2 million acres over the previous year. This produced an additional 27.6 million bushels of the grain.

Barley is adaptable to a wide variety of climatic conditions, and is produced commercially in 36 States. In many areas, however, barley must compete for land with the more profitable corn, sorghum, and soybeans. So its production has become concentrated in the Northern Plains and Pacific Coast States where the other grains cannot adapt as well to the climate.

North Dakota, California, and Montana account for 50 percent of the Nation's barley. Idaho and Minnesota produce another 21 percent. Of these top five producers, all except California increased the percentage of acreage seeded to malting barley between 1970 and 1975. About 97 percent of the barley grown in North Dakota is now of the malting variety, with 98 percent in Minnesota, 61 percent in Montana, and 50 percent in Idaho. Most of the California barley, about 99 percent, is seeded to feed varieties.

Three-fourths of the malt processing capacity in the United States is centered in Chicago, Minneapolis, and Milwaukee. Converting malting barley to malt involves sprouting of the kernels, which converts the starch content to a form of sugar. Although malt is a food product, a major portion is used to produce alcohol and alcoholic beverages. The brewing industry uses about 90 percent of the malt produced, which in turn accounts for two-thirds of the total grain and grain products used by breweries. Corn grits and brewer's rice make up the other third.

Indications are that there will be a continuing increase in beer consumption in this country, which will require greater quantities of malting barley. This will maintain barley as a major crop in the face of a declining use for animal feed.

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INTRODUCTION

Barley, one of civilization's oldest cultivated crops, is grown in nearly every country of the world. It is one of the four major feed grains produced in the United States, with production averaging about 400 million bushels annually during the seventies. This report describes the U.S. barley industry and analyzes the major changes that have occurred in the industry since 1950.

In recent years, changes occurred in the industry which reversed previous trends in production, consumption, and prices. The Agricultural Act of 1973 changed the national wheat program and relaxed the set-aside requirements and planting restrictions on wheat. This program change and a greater emphasis on food grain production resulted in large increases in wheat acreage and significant decreases in barley acreage. In 1974, barley acreage dropped from over 11 million acres to about 9 million acres. Acreage planted was below 10 million acres for 3 years in a row (1974-76).

The decreases in acreage resulted mainly in less feed barley production. Feed barley, like oats and rye, is a lower valued crop in relation to wheat, corn, sorghum, and soybeans. In years when producers are not regulated by the provisions of a farm program, acreages of the lower value crops tend to decrease in favor of the more profitable crops. In contrast, the acreage planted to malt barley varieties has generally increased over time. Malt barley has commanded a higher price than feed barley in recent years, and producers have had greater incentives for maintaining production to meet the demands of the malting industry. Maltsters also enter production contracts with farmers at many locations, a practice which tends to stabilize the supply of this type of barley.

Domestic utilization of barley malt for production of alcohol and alcoholic beverages has increased about 60 percent since the midfifties. Feed use and exports have fluctuated a great deal, depending upon the availability of feed barley and the supplies and prices of competing feed grains. Food use of barley has increased slightly over time, and generally reflects population

growth. Seed use has trended downward since the late fifties due to the downward trend in acreage seeded.

The structure of the barley industry has changed over time, reflecting changes in production location, production and marketing technology, and shifts in the demand for barley and barley products. The structural changes include the construction of new plants for malting and brewing, and increasing vertical integration in the processing industries.

BACKGROUND

Barley, with a wider ecological range than any other cereal grain, has been cultivated in areas of permanently frozen subsoil in the Arctic Circle and on the tropical plains in India. It was probably one of the first grains grown by man. Archaeologists have found clay documents more than 8,000 years old showing pictures of the brewing of beer. Barley kernels found in sites inhabited as long ago as 5,000 years before the Christian Era are practically identical to the barley now harvested in the same regions (32). 1/ Barley played a major role in the early advance of the Romans, especially in northern Africa. The Romans record barley as the staple food of all the northern lands they conquered. For its early history, readers are referred to works by Hedrick, Hill, and Weaver (5), (8), and (32).

Brought to the new world by early settlers, barley was probably sown for the first time in the United States in 1602 on Martha's Vineyard and Elizabeth Islands. By 1611, the colonists of the London Company were cultivating it in Virginia. By the middle of the 17th century, barley had become an important crop in the New World. The production of barley increased as the country was settled, and by 1796, it was listed as the leading agricultural product of Rhode Island. At that time, barley was used primarily for brewing purposes, and to a lesser degree as livestock feed. In years of wheat scarcity, barley flour was used to make bread.

The history of barley in the United States evolved around two distinctly different types of grain. In the early 1800's, varieties from England and Northern Europe were grown in the East for malting barley, and varieties from the Mediterranean region were grown in the West for livestock feed. In the late 1850's, a new variety of barley was discovered in eastern Manchuria. By 1872, this variety had been tried in Germany, and samples were sent to the Wisconsin Agricultural Experiment Station in Madison for research (4). Prior to this time, almost no effort had been made to improve the original strains which had been brought into the country by the colonists. From the original research in Wisconsin, a program of varietal selection and breeding was started which has continually improved barley culture to this time. Since about 1900, the U.S. Department of Agriculture (USDA) has built up a world barley collection of over 18,000 varieties for use in research work. 2/

1/ Underscored numbers in parentheses refer to the bibliography at the end of this report.

2/ This collection is maintained at the Germ Plasm Resources Laboratory, U.S. Department of Agriculture, Beltsville, Md.

In addition to production and varietal research conducted by agricultural experiment stations, private industry has had a continual program of research and development. Research and development has resulted in plant expansions and the adoption of new technology by the processing industries. 3/

During its early U.S. history, barley was grown primarily for malting. By the late 1800's, the demand for malt exceeded production, and barley was imported from Ontario, Canada. A tariff was imposed on all imported barley in 1890 which placed maltsters in the Northeast at a marketing disadvantage. This resulted in an eventual shift of the malting industry to the Midwest.

By 1900, nearly all the barley was grown in the North Central and Pacific Coast States. The United States was exporting about 10 percent of its total crop, mostly from the Pacific region. Principal foreign markets were the United Kingdom, Australia, and Portuguese Africa. At the turn of the century, barley accounted for about 4 percent of the U.S. cropland acres (10), and by 1905 ranked seventh among all agricultural products of the Nation (30).

The acreage harvested nearly doubled from 1900 until the beginning of World War II, but yields per acre did not increase significantly. In fact, throughout this 40-year period, average yields were often less than they were in the late 1800's. Total production fluctuated greatly, reflecting the effects of Prohibition, a corresponding reduction in plant breeding research, the drought of the thirties, and disease problems in the Midwest production areas. The geographical shift of production to lower rainfall areas also was a factor.

The 18th Amendment 4/ was one of the leading factors influencing the production pattern that existed during the inter-war period. The acreage of harvested barley fell from 9.2 million in 1918 to 6.6 million in 1919 as maltster demand declined sharply. Barley used in making alcoholic beverages decreased sharply to about 4 million bushels in 1930 (23). Conversely, barley used for food purposes increased considerably by the same year.

In 1934, immediately after prohibition, the volume of barley used to produce malt for alcoholic beverages increased to over 50 million bushels. The volume of barley used for feed and other uses dropped from 243 million to 61 million bushels.

To meet the increased food needs during World War II, wheat acreage allotment provisions were suspended, and farmers responded by increasing the acreage of wheat harvested each year from 1942 to 1946. Being a lower valued crop than wheat, barley acreage decreased in each of these years, and did not reverse the trend significantly until 1954 when restrictions were placed on wheat acreage due to large wheat stocks.

3/ The malt barley industry pioneered mechanical refrigeration and air conditioning.

4/ The 18th (Prohibition) Amendment to the U.S. Constitution became effective Jan. 16, 1920, and remained in effect until Dec. 5, 1933. The 34th and last State to ratify the amendment did so on Jan. 16, 1919.

SUPPLY

Barley available for domestic use or for export from the United States each year consists of three major components: production, stocks, and imports. Harvest of the crop takes place during the summer. About 50 percent of off-farm sales by farmers occur during the harvest quarter, and the balance of sales occur throughout the remainder of the year. Since consumption takes place throughout the marketing year, the stock component serves the function of distributing the available supplies over time until the following crop is harvested. Small quantities of barley and barley malt are imported, but imports are a relatively small component of total supply.

Production

Like wheat, barley is well adapted to the cooler and drier sections of the country, and is produced commercially in 36 States. It is generally less profitable than corn, sorghum, and soybeans. As a result, barley production has become concentrated in Northern Plains and Pacific Coast States where the other grains cannot adapt as well to the climate. Since wheat is also grown in these areas, Government programs and other factors that affect the wheat acreage have an impact on barley acreage.

Trends in Acreage, Yield, and Production

The yearly acreage of barley has varied considerably since 1950 when 13 million acres were planted (table 1).

After a steady increase from 1950 to 1965, barley yields leveled off (table 1). Yields in the seventies suggest that the trend of increasing yields is probably leveling off. The average yield declined in 3 of the 4 years between 1971 and 1976 due largely to adverse weather conditions.

Production generally increased during the fifties due to both increasing acreage and to increasing yields (table 1). In the sixties, acreage declines were usually offset by higher average yields, and production averaged about 404 million bushels. Instability has been the trademark of the seventies. Throughout the 1950-76 study period, production accounted for between 60 and 75 percent of total supply, and served as the major source of malting barley. Production trended downward in recent years because of reduced acreages (table 2). The downward trend in acreage planted to barley is closely related to trends in the acreage of other field crops. Barley leads only rye and rice in terms of area planted, and ranks fourth among the major feed grains. The emphasis on increasing production of wheat, corn, and soybeans had an adverse impact on the area planted to feed grains other than corn. In 1974, there was a noticeable shift in acreage from barley, oats, and rye to durum and other spring wheats.

The acreage of barley appears to have reached a level where further declines are not likely. On the other hand, future increases in barley and oat acreage depend to a large extent on changes in the acreage of spring wheat.

Table 1--Barley: U.S. acreage, yield, production, and disposition

Crop year	Acreage seeded for all purposes 1/	Acreage harvested for grain	Yield per harvested acre	Production	Disposition 2/	
					Used on farm	Sold from farms
	--1,000 acres--		Bushels	----Million bushels----		
1950	13,010	11,155	27.2	303.8	108.6	195.2
1951	10,790	9,424	27.3	257.2	102.1	155.1
1952	9,190	8,236	27.7	228.2	88.3	139.8
1953	9,615	8,680	28.4	246.7	88.0	158.7
1954	14,740	13,370	28.4	379.3	128.0	251.3
1955	16,293	14,523	27.8	403.1	142.9	260.1
1956	14,732	12,852	29.3	376.7	126.7	250.0
1957	16,398	14,872	29.8	442.8	143.9	298.9
1958	16,150	14,791	32.3	477.4	148.4	329.0
1959	16,766	14,869	28.3	420.2	132.2	288.0
1960	15,527	13,856	31.0	429.0	136.7	292.3
1961	15,623	12,806	30.6	392.4	118.5	273.9
1962	14,380	12,214	35.0	427.7	130.4	297.4
1963	13,452	11,236	35.0	392.8	110.8	282.0
1964	11,652	10,277	37.6	386.1	91.4	294.7
1965	10,123	9,166	42.9	393.1	92.9	300.2
1966	11,184	10,250	38.3	392.1	103.8	288.3
1967	10,077	9,230	40.5	373.7	104.1	269.6
1968	10,486	9,736	43.8	426.2	110.4	315.8
1969	10,291	9,557	44.7	427.1	116.3	310.4
1970	10,490	9,725	42.8	416.1	114.8	301.3
1971	11,115	10,151	45.7	463.6	125.7	337.9
1972	10,639	9,707	43.6	423.5	110.0	313.5
1973	11,229	10,452	40.3	421.5	111.1	310.4
1974	8,994	8,168	37.2	304.1	84.1	220.0
1975	9,536	8,743	43.9	383.9	102.9	281.0
1976	9,296	8,417	44.8	377.3	96.6	280.7

1/ Includes barley sown in the preceding fall.
2/ Disposition of a given year's production regardless of time of actual disposition.

Source: (23).

Table 2--Total supply of barley available by marketing year

Year beginning June 1	Beginning inventory	Production	Imports	Total supply
		Million bushels		
1950	95	304	14	412
1951	114	257	13	384
1952	90	228	24	342
1953	66	247	37	350
1954	88	379	26	494
1955	154	403	26	583
1956	147	377	28	552
1957	148	443	24	615
1958	197	477	15	689
1959	229	420	18	667
1960	191	429	15	634
1961	178	392	20	590
1962	149	428	6	582
1963	171	393	13	576
1964	162	386	12	560
1965	133	393	8	534
1966	133	392	7	532
1967	148	374	9	531
1968	161	426	10	597
1969	225	427	13	665
1970	269	416	10	695
1971	184	464	12	660
1972	208	423	17	648
1973	192	422	9	623
1974	146	304	20	470
1975	92	384	16	492
1976 1/	129	377	11	517

1/ Preliminary.

Source: (23), (25).

In 1977, for example, the acreage of spring wheat other than durum declined 1.6 million acres, while the acreage seeded to barley and oats increased by 1.2 million and 0.5 million acres, respectively.

Production Location

There have been noticeable changes in the location of production since 1950. The most significant changes occurred in the West North Central region where acreage harvested declined from 6.8 million acres in 1955 (a post-fifties high) to 3.2 million acres in 1970 (a low for the study period). The South Central region registered an 82-percent decline in acreage between 1960 and 1975, and accounted for only 2.4 percent of acreage in 1975. A comparable decline occurred in the East North Central region after 1955.

Acreage harvested in all States of the West North Central region declined significantly during the study period with the exception of North Dakota. North Dakota, South Dakota, and Minnesota account for about 97 percent of the harvested acreage in that region. The proportion of harvested acreage located in the West increased during the study period due to significant acreage increases in Washington, Idaho, and Montana. These three States plus California account for about 80 percent of acreage in the West. The major reasons for acreage declines and shifts in production location during the study period are: (1) barley disease problems; 5/ (2) increases in the acreage of more profitable crops such as corn, wheat, sorghum, and soybeans; and (3) a concentration of malting barley production.

North Dakota was the leading barley-producing State in 1976, accounting for 21.6 percent of total production and 25 percent of the total acreage harvested. North Dakota, California, and Montana accounted for about 50 percent

5/ Diseases affecting midwestern barley are known as the black point complex: Scab, Alteraria, and Helminthosporium. Scab (Fusarium, roseum), results in a pink mycelum growth on the kernels. Eventually the kernels shrivel and a loss of germination occurs, resulting in the loss of malting quality. Barley is most susceptible to these diseases at heading time in areas of high humidity or heavy dews. Loose smut is also a problem in high moisture areas where it strikes the plant at flowering time. While diseases of barley have affected acreages and location of production, diseases in other crops have a favorable effect on barley production. For example, diseases in such crops as wheat make it imperative that barley or some other spring crop be planted in crop rotations in some parts of the United States to break disease cycles of other crops.

of the Nation's production and acreage. The leading barley-producing States in 1976 were:

State	Production		Acreage harvested	
	Percent	Rank	Percent	Rank
North Dakota	21.6	1	25.4	1
California	15.0	2	12.0	3
Montana	13.8	3	13.9	2
Idaho	11.4	4	9.5	5
Minnesota	9.2	5	10.2	4
Washington	5.6	6	4.6	6
Colorado	3.6	7	2.9	7
Total	80.2		78.5	

The three States west of the Rocky Mountains rank higher in terms of production than in acreage harvested because of relatively higher average yields per acre. In general, production is becoming more concentrated in States where high quality malt barley can be produced.

Production Practices

Production of high-quality malting barley requires good farm management practices. High protein content in barley is desirable for feed use but not for malting use. Yield and protein content may be increased by raising fertilizer application rates, provided other growing conditions are favorable. Test plot experiments have shown that phosphate alone frequently improves malting quality, and results in a higher percentage of plump kernels. These tests also indicate that phosphate fertilizer results in barley having a higher malt extraction rate (24). Other research has demonstrated that hot and dry weather coupled with high rates of nitrogen application will often result in barley with a protein content too high for malting. 6/ Lodging, due to heavy fertilizer application rates and excess precipitation, also may result in grain of poor malting quality.

Most barley is seeded in the spring. The principal genetic difference between winter and spring varieties is that true winter varieties require vernalization to mature and produce seed. Without vernalization, a winter

6/ Based on test plot data generated by Dr. Paul Brown, Agr. Res. Serv., U.S. Dept. Agr., formerly stationed at Montana State Univ., Bozeman, Mont., and analyzed by Heid to determine profit maximizing levels of nitrogen application (Unpublished mimeo, 1969).

barley would produce only forage. A detailed discussion of the difference between spring and winter barley may be found elsewhere (24, p. 63).

Barley is grown under different cropping systems in various parts of the United States. In the arid parts of the Northern Great Plains, where production is concentrated, barley is seeded in the spring on land that has been fallowed during the preceding year. Malting varieties are often seeded on irrigated land in this area since the protein level can be more easily controlled. Approximately 20 percent of the U.S. barley crop was irrigated in 1973. In the more humid parts of the Northern Great Plains and areas east of the Great Plains, spring barley is grown as part of a continuous-cropping rotation. In this system, barley is normally seeded on land that has been fall plowed and fallowed over winter. Although most California barley is the spring type, it is often planted as the second crop of a double-cropping rotation.

Winter barley is sometimes seeded in the fall in the North, but this practice is not common due to the lack of winter hardiness. Winter barley is most prevalent in the South where it is used for winter pasture as well as for grain production.

No data are published on minimum tillage practices for barley in the United States. Given the current interest in energy conservation, minimum tillage undoubtedly is being considered by researchers and tried by some producers.

The usual planting and harvesting dates for barley are shown in table 3. Winter barley is usually seeded 1 or 2 weeks earlier than winter wheat in the fall. Seeding rates of 120 to 148 pounds per acre are common in areas where it is used for winter grazing. Spring barley is seeded in the spring. In dryland areas, seeding rates vary from 46 to 48 pounds per acre. Timely seeding and early maturity are important for malting barley. Late seeding may result in thin kernels, low test weight, and reduced yields. As a result, producers often substitute spring wheat when seeding is delayed by bad weather unless they are restricted by Government programs.

Barley can be combined directly from standing grain, or windrowed and combined from the windrow. Quality may be improved by windrowing or swathing when the beards are a golden yellow and the straw is still slightly green. Windrowing not only prevents shattering, but also improves malting quality; however, windrowing in the presence of rain may result in sprout damage. Special care must be taken when harvesting malting barley to properly adjust the cylinder speed and concave setting of the combine to avoid cracking or skinning the kernels because only whole kernels capable of sprouting can be used in the malting process.

Varieties and Types

Varieties of barley grown in the United States are classified as malting and feed. The malting varieties may be further classified as two-rowed and six-rowed, each having unique properties and special malting qualities. The

Table 3--Usual planting and harvesting dates for barley in major States 1/

State and sowing season	1975 Harvested acreage	Usual planting dates	Usual harvesting dates		
			Begin	Most active	End
	1,000 acres				
Pennsylvania:					
Fall sown	155	Sept. 10-Oct. 1	June 20	June 25-July 5	July 10
Spring sown		Apr. 25-May 25	July 25	Aug. 1-Aug. 15	Aug. 20
Minnesota	850	Apr. 15-May 30	July 25	Aug. 1-Aug. 20	Sept. 10
North Dakota	1,990	Apr. 20-June 1	Aug. 1	Aug. 10-Aug. 25	Sept. 5
South Dakota	570	Apr. 5-May 10	July 15	July 25-Aug. 10	Aug. 15
Maryland	100	Sept. 15-Nov. 10	June 10	June 20-July 10	July 15
Virginia	104	Sept. 5-Nov. 1	June 1	June 20-July 1	July 15
Montana	1,300	Apr. 10-May 30	Aug. 5	Aug. 10-Aug. 25	Sept. 15
Idaho:					
Fall sown	755	Sept. 1-Oct. 15	July 15	July 25-Aug. 20	Sept. 1
Spring sown		Mar. 25-May 25	July 25	Aug. 5-Sept. 15	Sept. 30
Wyoming	134	Apr. 5-May 20	Aug. 1	Aug. 5-Aug. 20	Sept. 1
Colorado:					
Fall sown	265	Sept. 1-Oct. 15	June 20	July 1-July 20	Aug. 5
Spring sown		Mar. 15-Apr. 30	June 30	July 5-Sept. 10	Sept. 20
Arizona	115	Oct. 1-Feb. 15	May 20	May 25-June 30	July 10
Utah	135	Mar. 20-Apr. 25	Aug. 1	Aug. 20-Sept. 1	Sept. 10
Washington:					
Fall sown	400	Sept. 1-Nov. 10	July 1	July 15-Aug. 10	Aug. 20
Spring sown		Mar. 10-Apr. 1	July 5	July 20-Aug. 15	Sept. 1
Oregon:					
Fall sown	177	Aug. 15-Feb. 1	July 5	July 15-Aug. 10	Aug. 20
Spring sown		Feb. 15-May 15	July 25	Aug. 5-Aug. 25	Sept. 15
California:					
Fall sown	1,060	Oct. 1-Apr. 15	May 15	June 1-July 15	Aug. 15
Spring sown		Mar. 1-May 1	Aug. 15	Sept. 1-Sept. 20	Sept. 30

1/ States in which harvested acreage was 100,000 acres or more in 1975.

Source: (21).

English, Swedes, and Germans introduced two-rowed barley to America, and the Dutch and Spanish introduced the six-rowed varieties. Those interested in the composition and properties of the different types of malting barley are referred to (24, p. 118).

A great deal of experimentation on kernel dimension has been performed by barley breeders, maltsters, and brewmasters. Two-rowed varieties generally have different enzyme potential, a different ratio of protein to carbohydrates, larger kernels, and slower water absorption. Consequently, they respond differently to malting conditions normally used for six-rowed barley, and cannot be mixed with six-rowed varieties in the malting process (11). Until the last few years, most six-rowed varieties yielded more malt than two-rowed varieties. More recently, malt yields of most two-rowed varieties have increased, and maltsters currently pay premiums for high-quality two-rowed barley.

The percentage of total acreage seeded to malting varieties usually exceeds the percent of total disappearance used for malting purposes. Producers plant malting varieties in anticipation of producing a high-quality malt barley and receiving a relatively higher price than that of feed barley. Not all barley produced from malting varieties, however, is of an acceptable quality for malting because of such factors as high protein or lack of plumpness. Maltsters encourage producers to plant malting barley, and in some cases enter into production contracts with malt barley producers. This usually assures maltsters of an adequate supply of malting barley.

Data published in the 1975 Annual Report of the Malting Barley Improvement Association (13) indicate an estimated 36 percent of the 1975 acreage was seeded to six-rowed malting varieties, 12 percent to two-rowed malting varieties, and 52 percent to other varieties. Production of six-rowed malting barley is concentrated in Minnesota, North Dakota, and South Dakota, with malting varieties accounting for over 91 percent of the planted acreage in these States in 1975. Two-rowed malting barley is grown mainly in Montana and Idaho, with smaller acreages in Washington and Oregon. Even though the barley acreage in California is mostly feed varieties, it is sometimes used for malting purposes. Most varieties are developed for the growing conditions of particular areas, and major emphasis is given to the improvement of quality, yield, and disease resistance.

Malt barley must meet certain specifications in terms of size, plumpness, and protein to be acceptable to maltsters. For example, some maltsters prefer not to accept barley exceeding 14 percent protein content. The reason for such strict specifications is related to the uniformity needed in sprouting and the quality control that is desired in the finished product--beer. Maltsters generally prefer barley with at least 80 percent plump kernels. Barley with more than 15 percent thin kernels cannot be classified as malting or blue malting barley under U.S. standards for barley.

Imports

Small quantities of barley are imported for malting purposes (table 2). These imports generally come from Canada and are blended with domestic barley by maltsters. Imports averaged over 22 million bushels per year during the fifties, but declined to an average of only 11 million bushels during the sixties. The volume imported increased significantly during 1974/75 due to a tight supply situation in the United States.

Barley imports are highly seasonal in nature. Since 1950, about 47 percent of the imports entered the United States during the June-September period or immediately after the Canadian harvest. The October-December period has accounted for 31 percent of annual imports on the average. An average of only 22 percent of the total has entered during January-May. As it is desirable to segregate the new crop of malt barley at least 4 months before malting to ensure identity preservation, imports are generally greater in the first part of the marketing year. For example, harvest in the Northern Plains begins during late July; therefore, this barley is not available for malting before late November. Thus, in years of tight supply, earlier harvested imports are used to supplement old-crop stocks of malting barley during the summer and early fall.

Stocks

The final component of supply is stocks. The carryover of old-crop stocks into the new marketing year represents a net addition to the supply available for use during the year. 7/ Data are collected periodically by USDA, and stock reports are issued quarterly.

Carryover stocks represent excess supplies from the previous marketing year as well as working inventories. As previously noted, maltsters need a 4-month supply of old-crop malting barley to use until new-crop barley is ready for malting. In addition, farmers and livestock feeders require pipeline stocks during the transition from one marketing year to the next. The quantity of barley carryover from 1950-76 and the relationship of stock volumes to other supplies are shown in table 2.

The variation in carryover stocks during the study period largely reflects changes in inventories controlled by the Government (under loan and owned by the Commodity Credit Corporation (CCC)). In general, higher total carryover levels reflect greater Government involvement rather than an increase in privately controlled stocks. Privately owned stocks have trended

7/ The marketing year for barley was changed from July 1-June 30 to June 1-May 31 beginning in 1976. Carryover stocks are now reported for June 1.

upward over time as utilization has increased, reflecting greater needs for working inventories. This trend is evident in the following 5-year averages:

Period	Average carryover (mil. bu.)		
	"Free"	Government	Total
1955-59	50.2	97.8	148.0
1960-64	76.2	67.8	144.0
1965-69	85.8	47.2	133.0
1970-74	101.8	67.8	169.6

This increasing trend in "free" carryover is also due in part to declines in the quantity under Government control. Quantities owned by CCC and loan grain stored off-farm have usually been stored on a commingled basis. Thus, a grain firm could sell old-crop barley under Government control and simultaneously replace it with new-crop barley of a similar quality without violating any regulations governing the storage of loan and CCC-owned barley stocks. Consequently, the existence of these inventories reduced the need for privately owned carryover stocks in the past. The involvement of Government will be considered in greater detail in a later section.

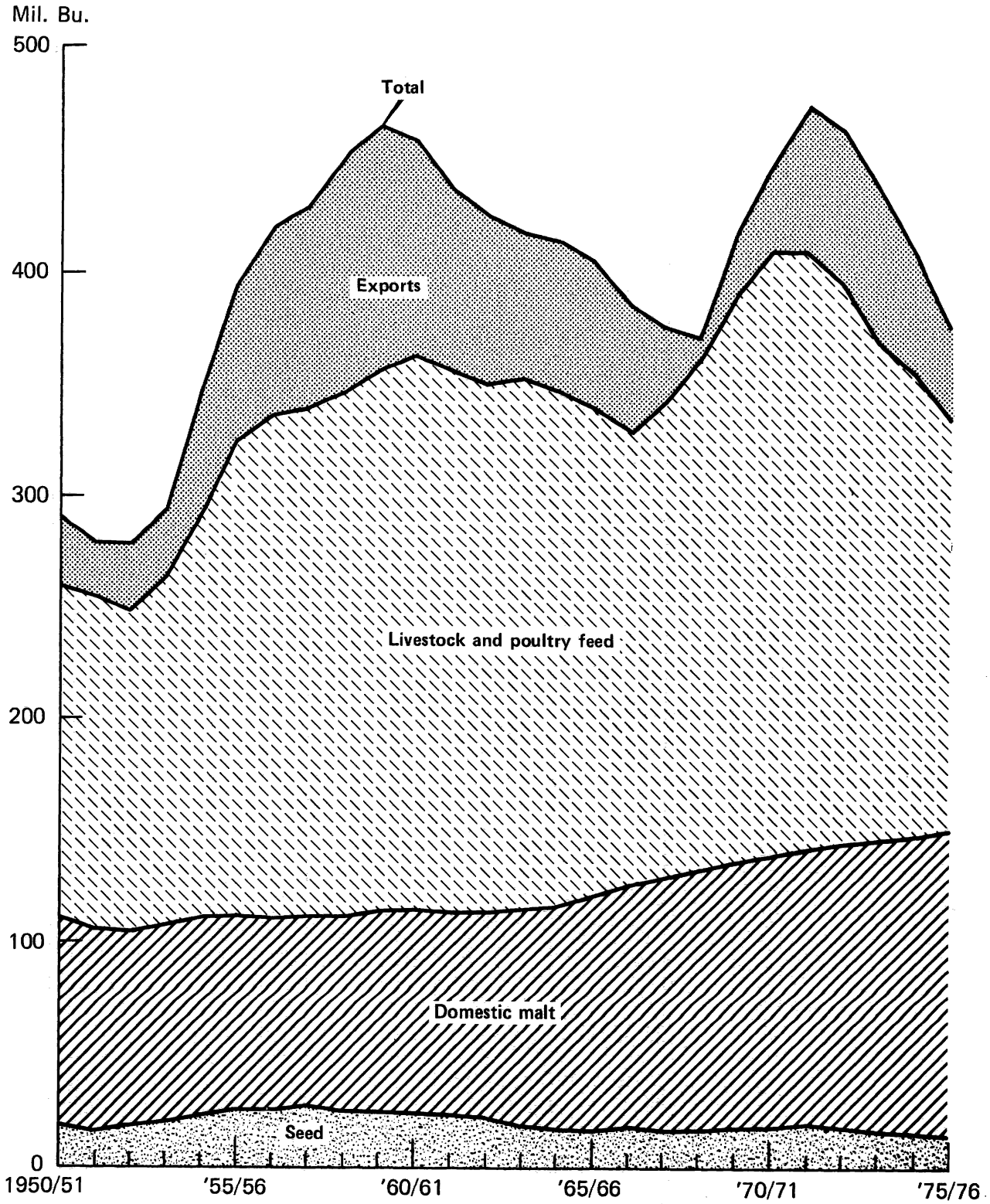
Trends in Supply

No long-term trend in overall barley supply has occurred in the last quarter century. Rather the supply has increased and decreased depending on harvested acreage, yields, exports, and other factors. During this period there has been increased emphasis on malting varieties, especially two-rowed barley, as well as some shift in production areas. The supply of barley throughout the study period probably was affected more by decisions to plant other crops, wheat in particular, than by any other factor.

DEMAND

U.S. utilization of barley consists of four major demands: livestock and poultry feed, malting, seed, and export. The relative importance of these demands is illustrated in figure 1. Livestock and poultry feed is the major domestic use of barley. Feed usage and exports exhibit a great deal of variation due to changes in supply and price relationships. In contrast, the volume processed by the malting industry increased steadily

Major uses of barley



3-year moving averages.

Figure 1

during the sixties and seventies. The increasing demand for malting barley primarily reflects the tremendous growth that has occurred in the production of beer and cereal beverages in the United States.

Domestic

Domestic utilization trended upward during the fifties and sixties, and reached a record high of 427 million bushels in 1970/71 marketing year (table 4). Domestic utilization later declined by 88 million bushels or about 20 percent. Currently, domestic use is about the same level as existed prior to the rapid increase that began in 1968/69.

Feed

The major domestic use, livestock and poultry feed, reached a record high of 289 million bushels in 1970/71. This use declined during the following years, and accounted for less than 200 million bushels during 1974/75 and 1975/76. About half of the barley used for feed is used on farms where produced. The balance is processed by feed manufacturers or purchased by livestock feeders from off-farm sources. In addition to whole barley, prepared animal feed (PAF) manufacturers use barley rootlets, barley screenings from the steeping process, and spent barley from maltsters, brewers, and other food processors. Quantities of barley used by PAF manufacturers and other processors for census years 1947, 1958, 1967, and 1972 are shown in table 5.

The declines in feed usage during the seventies corresponds closely with declines in domestic supply that occurred during the same period. Thus, feed usage of barley depends to a large extent upon the availability of feed barley. Barley is the major feed grain produced in many States in the West, and the quantity available appears to be the major constraint on feed use in that region.

Malt

In contrast to the declining feed use during the seventies, the quantity used annually by the malting industry continued an increasing trend that began in 1960. The barley malt produced by the malting industry is distributed for use in making alcohol and alcoholic beverages, for food uses, and for export. Food use and exports remained fairly stable throughout the study period, while the quantity used for alcohol and alcoholic beverages increased significantly.

The quantity consumed as food increased gradually after the mid-1950's. Per capita use of malt for food purposes remained steady at 1.2 pounds per person after 1965; therefore, the increase in food use reflects growth in the population.

Table 4--Disappearance of barley by use

Year beginning June 1	Disappearance								
	Domestic					Exports			Total disappearance
	Used as malt for:		Seed 3/	Livestock feed 4/	Total	Grain	Malt	Total	
	Alcohol and alcoholic beverages 1/	Food uses 2/							
	Million bushels								
1950	91	6	18	147	261	33	4	37	299
1951	83	6	15	157	261	28	5	33	294
1952	78	6	16	140	239	32	5	37	276
1953	81	6	24	134	245	12	5	17	262
1954	79	5	26	188	298	37	4	41	340
1955	82	5	24	228	339	93	4	97	437
1956	81	5	26	223	335	64	5	69	404
1957	77	5	26	225	333	81	5	86	419
1958	81	5	26	234	346	110	4	114	460
1959	84	5	24	241	354	118	4	122	476
1960	82	6	25	254	367	86	3	89	456
1961	84	6	23	250	363	76	2	78	442
1962	84	6	21	228	339	70	3	73	411
1963	88	7	18	233	346	65	3	68	414
1964	92	7	16	252	367	57	2	59	426
1965	96	7	17	203	323	76	2	78	401
1966	101	7	16	200	324	58	2	60	384
1967	103	8	17	206	334	34	2	36	370
1968	107	8	16	229	360	10	2	12	372
1969	112	8	16	250	386	8	2	10	369
1970	112	8	18	289	427	82	2	84	511
1971	116	8	17	270	411	38	3	41	452
1972	116	8	18	244	386	66	4	70	456
1973	120	8	17	239	384	90	3	93	477
1974	127	8	14	187	336	39	3	42	378
1975	127	8	14	190	339	21	3	24	363
1976 5/	----- 6/164 -----			180	344	-- 7/40--		40	384

1/ Compiled from reports of Internal Revenue Service. Includes small quantities of barley grain.
2/ Malt used for food, pearl barley, barley flour, and breakfast cereal.
3/ Based on acreage seeded following crop.
4/ Residual; includes other minor uses and waste.
5/ Preliminary.
6/ Uses as malt and seed are combined.
7/ Grain and malt exports are combined.

Table 5--Quantities of barley and barley products used by major industries

Industry	Units	1947	1958	1967	1972
Flour and other grain mill prod.:					
Barley	Mil. bu.	NA	4.3	2.8	3.0
Prepared feeds for animals & food:					
Barley	Mil. bu.	30.6	36.4	32.2	47.5
Brewers and distillers grains	1,000 tons	462.0	360.3	418.3	533.9
Cereal preparations:					
Barley	Mil. bu.	NA	1.3	1.6	1.1
Malt liquors:					
Barley	Mil. bu.	NA	NA	2.9	NA
Malt	1,000 tons	NA	1,407.1	1,551.8	1,742.4
Malt:					
Barley	Mil. bu.	NA	78.8	93.6	99.1
Malt	1,000 cwt.	NA	NA	490.9	477.9
Distilled liquor, except brandy:					
Malt	1,000 cwt.	NA	1,953.0	2,520.8	1,329.7

Source: (31).

The quantity of malt used for production of alcohol and alcoholic beverages (table 4) includes the amount used by the distilling and brewing industries. The average amount used by the distilling industry in the production of distilled spirits is as follows for selected periods:

Period (7/1-6/30)	Malt used (5-year average)
	Mil. bu.
1950-55	8.0
1955-60	6.4
1960-65	6.4
1965-70	6.6
1970-75	4.0

The preceding data suggest that distillers' use was fairly stable from 1955 to 1970, and declined after that. Annual use during the seventies declined from 5 million bushels during 1970/71 to 2 million bushels during 1974/75. Thus, the growth that occurred in domestic use of barley malt after 1960 is due almost entirely to increases in utilization by the brewing industry. The increased use was brought about by that industry's growth, which in turn reflects the increasing consumer demand, primarily for beer.

Production of beer and cereal beverages reached a record high of 158 million barrels in 1974/75, an increase of 69 percent since 1960/61 (table 6). Domestic consumption increased from 88 million barrels in 1960/61 to 147 million in 1974/75.

Barley malt utilization by the brewing industry did not increase as rapidly as malt beverage production after 1960 due to a declining per barrel use of barley malt by the industry. The quantity of malt use per barrel of beer produced declined from 30.1 pounds in 1950/51 to 26.8 pounds in 1974/75. This decline reflects changes in brewing technology as well as improvement in malt quality. Nevertheless, the quantity of malt used by the industry increased 59 percent after 1960, reaching 4,225 million pounds in 1974/75. This is equivalent to about 124 million bushels of barley.

Approximately 85 percent of the barley used for malting is of the six-rowed Manchurian type. Malt produced from the blue aleurone type is generally blended with malt produced from other barley types. Malt produced from two-rowed barley is used solely by some brewers while others blend it with malt produced from six-rowed varieties.

Seed

The downward trend in seed use during the sixties and seventies is reflected by declines in acreage planted. Seed use declined from 26 million bushels in the late fifties to 14 million bushels in 1975. The major factors that influence seed use are acreage planted and seeding rates per acre. Unless dramatic shifts occur in acreage, the seed demand will probably account for 14 to 18 million bushels in the near future.

Exports

Export demand has shown the greatest variability during the study period. Barley exports ranged from a record high of 118 million bushels in 1959 to a low of 8 million bushels in 1969 (table 4). An annual average of 56 million bushels has been exported during the seventies, but the volume has continued to fluctuate a great deal. Barley usually competes with other feed grains in foreign feed grain markets, although occasionally a quantity is demanded for malting purposes. Consequently, the availability of competing feed grains for export and the relative prices of other grains have an impact on barley exports. Exports also are influenced to some extent by poor crops in other countries.

Table 6--Production and taxpaid withdrawals[1/] of malt beverages and utilization of barley malt by the brewing industry

Year beginning July 1	Production of malt beverages	Total barley malt used	Barley malt used per barrel [2/]	Tax paid withdrawals	
				Total	Per capita
	1,000 barrels[1/]	Million pounds	Pounds	1,000 barrels[1/]	Gallons
1950	88,976	2,678	30.1	83,246	16.8
1951	89,601	2,656	29.6	84,294	16.8
1952	90,434	2,666	29.5	84,559	16.6
1953	92,561	2,728	29.5	85,747	16.5
1954	89,791	2,627	29.3	84,457	15.9
1955	90,698	2,651	29.2	85,357	15.9
1956	89,882	2,618	29.1	84,321	15.3
1957	89,011	2,578	29.0	83,949	15.0
1958	90,974	2,613	28.7	85,638	15.0
1959	94,548	2,697	28.5	88,929	15.4
1960	93,496	2,657	28.4	87,926	14.9
1961	96,418	2,715	28.2	90,693	15.1
1962	97,961	2,745	28.0	91,494	15.0
1963	103,018	2,885	28.0	96,247	15.6
1964	108,015	3,016	27.9	100,307	16.0
1965	109,736	3,072	27.5	101,510	16.1
1966	116,564	3,271	28.1	107,301	16.8
1967	117,524	3,310	28.2	107,470	16.7
1968	122,657	3,432	28.0	111,867	17.2
1969	134,654	3,721	27.6	122,550	18.7
1970	134,092	3,679	27.4	123,850	18.6
1971	140,372	3,854	27.5	130,741	19.5
1972	143,014	3,898	27.3	133,960	19.8
1973	153,053	4,168	27.2	142,312	20.9
1974	157,870	4,225	26.8	146,853	21.4

1/ IRS taxes paid on sales leaving a brewery.
2/ One barrel equals 31 gallons.

Source: (20).

Malt exports amounted to only about 3 million bushels in recent years. This level is slightly above exports during the sixties. Exports currently account for only 2 percent of the barley malt produced in the United States.

Trends in Demand

The demand for barley has exhibited a general upward trend since 1950, although during the fifties, the demand for malt trended downward. Since 1960, domestic use as malt has exhibited a steady upward trend. The quantity of malt used for food and alcoholic beverages is expected to continue to increase in the future.

Future growth of the malting industry will depend almost entirely on future increases in consumption of malt beverages. Estimates of malt usage by the brewing industry for selected years are shown below: 8/

Year	Million pounds	Million bushels
1980	4,785	140.7
1985	5,371	158.0
1990	5,958	175.2
1995	6,544	192.5
2000	7,131	209.7

Based on data for recent years, utilization of malt for alcohol, food, and export is expected to increase to over 200 million bushels annually before year 2000. This is equal to an annual rate of increase in malt output of about 3.5 percent.

8/ These estimates were computed as follows:

$$Q_D = 2439.53 + 117.275\ T$$

where

Q_D = quantity used by brewers

$r = 0.9931$

$T = 1,2,3,\ldots,$ 1960 = 1.

These estimates are considerably lower than the projection of 180 million bushels in 1981 by Fraase and Anderson (2, p. 17). Their projection was based on an assumption that brewers use "roughly one bushel of malt to produce one barrel of beer." This is about 26 percent more malt per barrel than brewers are currently using (table 6). Their projection of malt use for 1976 was 150 to 160 million bushels, which appears to be an overestimate. In 1970, another industry source projected that 230 million bushels of barley would be needed for malting by 1985 (33). A growth in the demand for malt of this magnitude in the next 10 years does not appear likely. This projection was based on the expected population growth in the 20-34 age group.

The projections of growth in malt demand suggest that the industry must continue to expand capacity at about 3-4 percent annually during the future. This new capacity will likely be built by firms already in the industry. Building and operating a malthouse requires extensive knowledge of malting technology, established outlets for the malt, and a strong financial position. These considerations will certainly favor the larger malting firms or larger breweries that want to expand their malting operations. The investment and expertise required provide strong barriers to smaller existing firms or to entry by firms not currently in the industry. The investment and costs associated with a new malt plant will be discussed later in the section entitled Costs.

The quantity used for livestock feed has exhibited a great deal of variation during the study period. The demand for barley for feed purposes exhibited a downward trend during the seventies. This trend will be reversed only if the supply of feed barley increases in future years.

Barley exports have generally trended downward since 1959. The prospects for increases in the future are not great since most importers of feed grains show a preference for corn when it is available.

PRICES

Price directs the use of production resources among competing farm enterprises and determines the income derived from ownership of these resources. The interaction of the forces of supply and demand establishes the overall price level at central markets. The importance of prices in directing the use of production resources, in allocating supplies over time and space, and in distributing income to owners of production and marketing facilities is well documented in economic literature. In the barley industry, prices over time and space are important indicators of industry performance and supply allocation efficiency.

Factors Influencing Barley Economy

The major factors that influence the supply-demand components of the barley economy are economic, physical, or institutional in nature. These represent variables that must be considered in future research designed to quantify relationships in the feed grain economy.

National grain programs have been a major factor affecting barley supply since 1950. A recent study of factors affecting acres planted determined that barley acreage was influenced by the barley loan rate, previous year barley prices, acreage diversion payments, the oat loan rate, wheat acreage, and acreage diverted under the wheat program (16). All of the factors considered, except barley prices and wheat acreage, were institutional in nature, and have become less important under the agricultural policies of the seventies.

The relationship between the prices received for malt and feed barley in the previous year and the expected prices in the current year influence the type of barley planted. Planting decisions are influenced by terms of prospective malting barley contracts as well as wheat prices. Weather at seeding time is also important, and seeding delays will usually result in a shift of some acreage to wheat. The supply and prices of other feed grains affect feed barley prices, and have an indirect impact on barley acreage.

Yields are also an important determinant of production. Yields depend on the variety and location of production, and are very sensitive to weather conditions, diseases, insects, and cultural practices.

Carryover of malt barley is an important factor influencing imports since malt barley must remain in storage for a period of 4 months prior to malting. Trade barriers could limit imports; however, they are not a limiting factor at this time.

The overall demand for barley is influenced by factors which affect individual components or uses. For example, the malting demand is a derived demand based on the demands for final products such as beer, alcohol, distilled spirits, malt, cereal, and other food products containing malt. The influencing factors are population, per capita consumption trends, disposable income, taxes on these products, product prices, and needs of importing countries.

The livestock-feed demand for barley is influenced by the supplies and prices of competing feed grains, and depends upon the number of grain consuming animals. Livestock-barley price relationships determine the profitability of feeding barley to livestock, and affect the feed demand for barley. Since one feed grain may be substituted for another in most livestock and poultry rations, the relative feeding value of grain (table 7) generally determines the relationship among the prices of those grains at specific locations. Thus, in periods of tight barley supplies, high barley prices relative to other feed grains will result in the substitution of other feed grains and reduce the feed demand for barley. Barley compares favorably with other grains in terms of feeding value when fed to dairy cattle and wintering beef cattle. The percentage of total digestible nutrients in barley is only slightly less than corn and sorghum (15). Barley is used extensively by feed manufacturers in major barley production regions.

The demand for seed depends to a large extent upon the acreage planted, and is influenced by the factors that affect acreage planted. The factors that affect barley exports are the same as those affecting exports of other

Table 7--Relative value of barley and other common feed materials compared with corn when fed to different types of livestock 1/

Item	Dairy cows	Fattening cattle	Wintering beef cattle	Hogs	Fattening lambs	Horses and mules	Poultry	Feed unit value, U.S. average
				Percent				
Grains:								
Corn	100	100	100	100	100	100	100	100
Oats	90	85	100	90	80	90	90	90
Barley	100	88	100	90	87	95	80	90
Wheat	105	105	--	103	85	95	105	105
Rye	90	95	--	80	85	--	--	85
Sorghum	100	92	100	90	100	95	95	95
Other concentrates:								
Gluten meal	165	225	--	175	200	--	--	165
Gluten feed	115	--	--	--	90	--	--	115
Brewers' dried grains	110	--	--	--	100	90	--	105
Distillers' dried grains (corn)	130	135	--	--	200	--	--	140
Wheat bran	95	--	75	--	90	85	70	90
Wheat middlings	100	--	--	105	--	--	90	100
Oat millfeed	45	35	--	30	35	45	--	40
Corn and cob meal	90	90	--	--	--	--	90	90
Hominy feed	100	100	--	95	100	100	100	100
Molasses (cane)	90	85	--	70	85	80	50	80
Dried beet pulp	90	90	--	--	90	--	--	90
Wet beet pulp	10	15	--	--	15	--	--	15
Alfalfa meal	65	--	--	70	--	--	70	70
Soybeans	170	200	--	150	200	125	100	160
Cottonseed	80	140	--	--	--	--	--	120
Cowpeas	--	--	--	--	--	--	--	120
Velvet beans	100	190	--	--	--	--	--	120
Peanuts	--	--	--	100	--	--	--	100

1/ These values assume that the feed is fed as part of a properly balanced ration, and that it is fed to livestock of the age to which it is suited.

Source: (26).

grains. Since barley exports are used for livestock feed, barley competes with other feed grains in the world market. Factors that influence the world supply and demand situation for feed grains are the economic conditions in the importing nations, world grain price relationships, trade barriers, and diplomatic relationships.

The price of barley and barley products, and the spread between these prices and the price farmers receive for barley, depends on the marketing system which adds time, place, and form utility to the products as they flow from producer to consumer. Barley and barley products flow through a succession of related industries between the farm and consumer. The barley economy depends upon the ability of these industries, as a whole, to adjust to changing flows and operate efficiently. Orderly marketing is also important and affects the barley economy. When occasional surges in barley receipts exceed the requirements at a market, temporary downward pressures are exerted on prices. Conversely, occasional shortages in receipts relative to requirements cause sudden increases in prices. These surges and shortages tend to be short run in nature, and do not affect the annual utilization to a great extent. In the case of feed barley, longer run phenomena of this nature would ultimately affect the quantity demanded and result in the substitution of other grains.

Determination

A dual pricing system is involved for feed and malting barley. The prices for each type reflect unique supply and demand forces, but the prices must relate in order to direct the use of production resources and guide planting decisions. Although barley is not traded on a U.S. futures market, feed barley competes directly with other feed grains which are traded on a futures market. The prices established for these grains have a direct impact on the price level of feed barley, and feed barley prices affect malting barley prices since maltsters must compete with the feeding industry for available supplies. The market recognizes a difference in value for feed barley and malting barley, and prices are quoted accordingly. The forces of supply and demand establish the overall price level for each of the barley types at the central market (Minneapolis is generally considered to be the central market for barley). These terminal market prices are reflected back and forward through the marketing system to guide decision-makers at all stages of the system.

The absence of a futures market complicates the pricing arrangements in contractual buying and selling of barley for future delivery. Pricing risk cannot be shifted from cash buyers and sellers to speculators. Consequently, when price is specified in a malt barley contract between producers and maltsters, producers assume the risk of missing the benefit of price increases while maltsters risk losses from decreases in market prices.

In the short run (a marketing year), total barley supplies are known and fixed. Consequently, the level of demand becomes the main determinant of price, and price becomes the rationing mechanism to bring supply and demand into balance. Current supply-demand relationships for other feed grains

influence feed barley prices, which generally exhibit a unique relationship to other grain prices at a particular location. Market prices for malt barley generally exhibit a premium or differential over feed barley prices because of the well-established demand for malt. This market premium provides an incentive for producers and marketers to segregate and maintain high-quality malting barley for the higher valued end uses.

In the longer run, price levels for barley are affected by general economic conditions, trade agreements, tariffs, world supply, and demand for grains in general. Supply influences planting decisions along with current and expected prices of barley and those of competing crops.

Prices for a portion of the malting barley produced in the United States are set by a production contract between producers and maltsters. Negotiated contract prices are normally based on anticipated feed barley prices. This works well in periods when prices are fairly stable; however, in years such as 1973 and 1974 when price levels change dramatically, this procedure is not very satisfactory. Consequently, contracts that specify a formula relating producer price to prevailing market prices at delivery time are becoming more common. Under this arrangement, the producer receives the market price plus any bonus involved, and the maltster is assured of a supply of the particular variety or type of barley specified in the contract.

Imperfections in price determination exist in the trading of barley. These imperfections can be related to a time lag between stimulus and quantity response. High barley prices at the terminal market one day result in large receipts a few days later after shipments are initiated at the country elevator level. Conversely, low barley prices are followed by a reduced level of receipts. These marketing patterns are reflected in surges and shortages in the supply at the terminal market and processing level. Other imperfections in price determination, equally disruptive or destabilizing to price discovery, are due to the lack of communication or awareness of changes in processing schedules and demands. These imperfections result in disorderly marketing and unstable prices, which are especially apparent in daily quotations.

Relationships

Price relationships are important to the barley economy and reflect industry performance. The relationships among various prices are not precise measures because of differences that exist in collection procedures and in product quality or type at each stage of the marketing system. For example, terminal prices are available on a daily basis, and generally reflect a certain class or grade. Monthly average prices at terminal markets reflect daily prices weighted by carlot receipts. The monthly prices received by farmers are simply the prevailing prices at midmonth, and are a weighted average of feed and malt barley prices. These limitations must be taken into consideration when drawing conclusions about selected price relationships.

Seasonal average prices received by farmers and terminal market prices for feed barley are presented in table 8. The difference between these prices

Table 8--Farm and terminal market prices for barley

Year 1/	Season average price received by farmers	Average market price at Minneapolis 2/	Difference in average prices
		Dollars per bushel	
1950	1.19	1.46	0.27
1951	1.26	1.36	.10
1952	1.27	1.52	.25
1953	1.17	1.40	.23
1954	1.09	1.32	.23
1955	.92	1.15	.23
1956	.99	1.20	.21
1957	.89	1.17	.28
1958	.90	1.15	.25
1959	.86	1.09	.23
1960	.84	1.07	.23
1961	.98	1.33	.35
1962	.92	1.11	.19
1963	.90	1.09	.19
1964	.95	1.20	.25
1965	1.02	1.32	.30
1966	1.06	1.33	.27
1967	1.01	1.23	.22
1968	.92	1.16	.24
1969	.88	1.08	.20
1970	.97	1.22	.25
1971	.99	1.16	.17
1972	1.21	1.48	.27
1973	2.13	2.81	.68
1974	2.80	3.84	1.04

1/ Farm prices for year beginning July, and market prices based on year beginning August 1.

2/ Prices computed by weighting selling prices by number of carlots sold for No. 3 barley.

Source: (22).

largely reflects the marketing cost (transportation and merchandising margins of country elevators) of moving feed barley to terminal or export positions.

Prices at Minneapolis and Duluth-Superior are generally the same. Since the two price series are based on different periods (market prices lag 1 month) the price difference tends to increase in periods of generally rising prices and vice versa. In addition, the difference should increase in periods of rising prices because farm marketings are more heavily concentrated in the first half of the marketing year. Thus, the lower prices in the early part of the year receive greater weight in the seasonal average. The greater risk and uncertainty involved in marketing during periods of unstable prices also influences the price difference. As a result, country elevators tend to increase their margins during periods of high and unstable prices. These factors were very evident in the price differences after 1972 when the spread rose to $1.04 per bushel in 1974. The flow from a specific production point moves to the market or processing location that offers the greatest return (delivered price less transportation charges).

Average annual prices for barley for selected markets and grades exhibit a fairly consistent relationship. However, changes in local supplies and demands alter the differentials in the short run. In years when supplies are limited relative to demand in a particular market, prices will rise and additional shipments will be attracted that would normally move to other markets. Likewise, when receipts at a market are greater than needs, prices fall in relation to other markets and receipts decline. Geographical shifts in production have had an impact on the volume traded at major markets.

General indicators of how the marketing system is performing over time are prices at various stages of the marketing system and the price spread between stages. Price spreads also reflect, in a general way, the increase in value (due to transportation, storage, merchandising, and processing) as grain or its products move through the marketing channel. Monthly prices received by farmers, monthly average prices for malt barley at Minneapolis, and average prices for brewers malt at Chicago are shown in table 9 for recent years. The price spreads implied by these prices are also shown for comparison purposes, although it should be pointed out that the comparison of farm prices with terminal malt prices in table 8 is not a comparison of like products. The farm price reflects a weighted price of feed and malt barley, whereas the terminal price is for malt barley only. On this account, the price spread between the farm and terminal market could have been overstated. However, this was not the case as the prices of feed and malt barley closely paralleled one another in the Minneapolis market throughout the study period. Feed barley prices tend to follow malt prices in major malt markets. In contrast, feed barley tends to follow corn in a major feed grain market such as Chicago. Thus, feed barley prices tend to vary widely at any given time.

The price spread at both levels of the system were very stable through 1972/73 when prices were generally stable. In contrast, the increasing price levels during 1973/74 and 1974/75 increased the spread between the farm and terminal market. Transportation costs increased significantly during this period; however, the data suggest that country elevator merchandising margins increased significantly to cover higher storage charges and offset the greater risk and uncertainty associated with higher and more unstable price levels.

Table 9--Prices and marketing price spread for barley and malt, 1971/72-1973/74

Crop year and month	Price received by farmers	Transportation and elevator price spread	Minneapolis No. 3 or better malting (choice)	Transportation and maltsters price spread	Brewers malt prices Chicago 1/
			Dollars		
1971/72:					
July	1.07	0.18	1.25	0.60	1.85
Aug.	.87	.23	1.10	.75	1.85
Sept.	.92	.19	1.11	.74	1.85
Oct.	.96	.21	1.17	.68	1.85
Nov.	1.02	.15	1.17	.68	1.85
Dec.	1.04	.13	1.17	.60	1.77
Jan.	1.04	.16	1.20	.57	1.77
Feb.	1.01	.18	1.19	.58	1.77
Mar.	.98	.21	1.19	.58	1.77
Apr.	.99	.20	1.19	.58	1.77
May	1.04	.16	1.20	.57	1.77
June	1.09	.13	1.22	.55	1.77
1972/73:					
July	1.04	.18	1.22	.55	1.77
Aug.	.96	.25	1.21	.56	1.77
Sept.	1.07	.19	1.26	.51	1.77
Oct.	1.17	.17	1.34	.43	1.77
Nov.	1.21	.13	1.34	.43	1.77
Dec.	1.32	.13	1.45	.32	1.77
Jan.	1.42	.17	1.59	.18	1.77
Feb.	1.34	.24	1.58	.33	1.91
Mar.	1.31	.30	1.61	.30	1.91
Apr.	1.31	.34	1.65	.39	2.03
May	1.39	.27	1.66	.37	2.03
June	1.55	.19	1.74	.29	2.03
1973/74:					
July	1.58	.24	1.82	.21	2.03
Aug.	2.10	.35	2.45	-.48	2.03
Sept.	2.16	.48	2.64	-.32	2.32
Oct.	2.23	.41	2.64	.19	2.83
Nov.	2.10	.52	2.62	.21	2.83
Dec.	2.19	.45	2.64	.42	3.06
Jan.	2.32	.44	2.76	.30	3.06
Feb.	2.52	.75	3.27	-.06	3.21

See footnote at end of table.

Continued

Table 9--Prices and marketing price spread for barley and malt, 1971/72-1973/74--Continued

Crop year and month	Price received by farmers	Transportation and elevator price spread	Minneapolis No. 3 or better malting (choice)	Transportation and maltsters price spread	Brewers malt prices Chicago 1/
			Dollars		
Mar.	2.61	.96	3.57	-.36	3.21
Apr.	2.15	.83	2.98	.59	3.57
May	2.19	.75	2.94	.89	3.83
June	2.25	.86	3.11	.72	3.83
1974/75:					
July	2.33	1.05	3.38	.45	3.83
Aug.	2.78	.99	3.77	.06	3.83
Sept.	2.86	1.14	4.00	.15	4.15
Oct.	3.11	1.31	4.42	.03	4.45
Nov.	3.44	1.37	4.78	-.33	4.45
Dec.	3.30	1.35	4.65	.20	4.85
Jan.	3.17	1.45	4.62	.43	5.05
Feb.	2.89	1.56	4.45	.55	5.00
Mar.	2.55	1.60	4.15	.85	5.00
Apr.	2.72	1.62	4.34	.66	5.00
May	2.75	1.53	4.28	.72	5.00
June	2.30	1.67	3.97	1.03	5.00
1975/76:					
July	2.35	1.48	3.83	1.17	5.00
Aug.	2.56	1.09	3.65	1.35	5.00
Sept.	2.69	1.24	3.93	.89	4.82
Oct.	2.68	1.15	3.83	.99	4.82
Nov.	2.43	1.13	3.56	1.06	4.62
Dec.	2.35	1.00	3.35	1.27	4.62
Jan.	2.31	.93	3.24	1.13	4.37
Feb.	2.31	.90	3.21	1.16	4.37
Mar.	2.34	.88	3.22	1.15	4.37
Apr.	2.31	.86	3.17	1.05	4.22
May	2.41	.81	3.22	.85	4.07
June	2.60	.95	3.55	.52	4.07

1/ 34-pound bushel, in bulk.

Source: Average prices received by farmers from Agricultural Prices, Stat. Rptg. Serv., U.S. Dept. Agr.; Minneapolis malt prices from Grain Marketing News, Agr. Mktg. Serv., U.S. Dept. Agr.; and brewers malt prices from the Brewers Bulletin, Chicago, Ill.

There appears to be a lag of about 3 months before terminal market price changes are reflected in brewer malt prices. For example, terminal prices began increasing rapidly during June 1974, and brewers malt prices responded in September of that year. The very low margins for transportation and malting during the fall of that year do not mean that maltsters were losing money. During August, September, and October they were still processing old-crop barley that was purchased during May and June at lower prices. Most maltsters have storage capacity for about a 4-month requirement, and malt is stored and aged for 4 weeks before shipment to brewers. Old-crop barley is used until October or November when new crop supplies are ready for malting.

A further comparison of price differences and trends was made using terminal prices. Minneapolis feed barley prices were compared with Chicago corn and Kansas City wheat prices for 1971/72 to 1973/74 marketing years. This period was selected because it was a time of rapidly changing grain prices. Barley was on average 18 cents a bushel less than corn during 1971/72. During 1973/74, the price differences averaged about 63 cents a bushel in favor of corn. In the case of wheat, the change in price relationship was even more pronounced, increasing from 50-59 cents in 1971/72 to over $3 in some months of 1973/74. Relative to corn and wheat, barley prices were affected less by the general drawdown of grain stocks. Barley prices generally do not exhibit a unique relationship to winter wheat prices based on feeding value; however, the barley-corn price relationship generally reflected feed-value differences.

The barley price increase between 1971/72 and 1973/74 relative to the increase for corn was very close to the response expected. Barley is almost 15 percent lighter than corn in weight per bushel, and the average feeding value is only 90 percent of corn pound for pound (tables 7 and 10). Consequently, the feed value of a bushel of barley is only 77 percent of that of a bushel of corn (48 lbs. X 90% ÷ 56 lbs. = 77%). The average corn price for 1973 was $2.73 per bushel, an increase of $1.51 over the 1971/72 average of $1.22 per bushel. The expected increase for barley would have been $1.16 per bushel (77 percent of $1.51). Between 1971/72 and 1973/74, barley prices on average increased by $1.06 per bushel ($2.10 - $1.04). This is only 10 cents less on average than would have been expected.

The wheat-barley price relationship is one of the important price relationships affecting the supply of malting barley. Wheat is the major crop competing for land where barley is grown. Costs of production are similar, making price differences (gross returns) an important factor in production decisions. Pricing provisions in malting barley contracts are normally based on malt barley prices of the previous year with adjustments to compensate for the anticipated malt-feed barley price difference in the contract year. This procedure works fine as long as there are acreage limitations on wheat production. However, in years of no wheat acreage limitation, contractors must consider the price of wheat in relation to malting barley values.

In the Northern Plains spring and durum wheat area and the Montana winter wheat area (which are also major malting barley areas), barley prices were considerably below the price of wheat in 1972/73 and 1973/74. The

Pacific Northwest white wheat price also exceeded the barley price. In each of the three cases, the price difference was greater in months of higher wheat prices.

Table 10--Whole grain weights, measures, and conversion factors

Grain	Pounds per bushel	Bushels	
		Per metric ton	Per quintal
	Pounds	- - - Bushels - - -	
Barley	48	45.9296	4.59
Buckwheat	48	45.9296	4.59
Corn:			
Shelled	56	39.6383	3.96
Ear husked	70	31.4946	3.15
Flaxseed	56	39.6383	3.96
Oats:			
Light	32	68.8945	6.89
Heavy	38	58.0164	5.80
Rice, rough	45	48.9916	4.90
Rye	56	39.6383	3.96
Sorghum grain	56	39.6383	3.96
Soybeans	60	36.7437	3.67
Wheat	60	36.7437	3.67

Miscellaneous factors:

Rice: 1 hundredweight of rough rice = 2.2 bushels
1 barrel of rough rice = 162 pounds or 3.60 bushels

Soybeans: 1 hundredweight of soybeans = 1.67 bushels

Sorghum grain: 1 hundredweight of sorghum grain = 1.78 bushels

1 metric ton = 22.046 hundredweight
1 metric ton = 2,204.623 pounds
1 short ton or ton = 2,000 pounds
1 long ton = 2,240 pounds
1 quintal = 220.46 pounds
10 quintals = 1 metric ton
1 hectare = 2.471 acres

In States where a major proportion of the feed barley is produced, the relation between feed barley prices and livestock prices is important in

influencing livestock feeding. The barley-hog ratio may be used in these States just as the corn-hog ratio is used in the Corn Belt. The barley-hog ratio is the price of hogs per 100 pounds divided by the price of barley per bushel. It represents the number of bushels of barley required to buy 100 pounds of live pork.

Changes in the barley-hog ratio influence the use of barley for feed. When barley is relatively cheap compared to hogs, the barley-hog ratio will increase and feeding barley to hogs becomes more profitable. For example, monthly barley-hog ratios for California and Montana were higher than average in 1972/73, and lower than average during the first half of 1974/75. Thus, an analysis of the barley feed demand for barley must consider indicators of the profitability of livestock production such as the barley-hog ratio.

COSTS

The costs discussed in this section are those associated with production, handling and storage, malting, and transportation.

Production

Approximately 85 percent of the barley produced in the United States is grown on nonirrigated land. In drier areas of North Dakota, Montana, and the Pacific Northwest, barley is produced in a summer fallow rotation. In other areas, barley is produced as a part of a continuous crop rotation. The development of higher yielding varieties and the increased application of commercial fertilizer have resulted in yield increases of about 15 bushels an acre in the past 15 years. Tillage practices have changed little, although machinery has become larger and more expensive.

Barley production costs have increased steadily. Enterprise budgets show that dry-land barley production costs were about $16 per acre in 1950 (12). Twenty-five years later, they had increased about 250 percent. In the last decade, both fixed and variable costs have doubled with land and taxes, accounting for 40 percent of the total increase in fixed costs. Costs of barley production in barley-fallow rotations are considerably higher since 2 acres of land are needed for each acre of production, and have increased accordingly. Also, production costs on irrigated land tend to be much higher than on dry land.

The results of a 1975 Economic Research Service (ERS) cost of production survey indicate that the average barley production costs, excluding land, were about $56 per acre. Data developed through the Firm Enterprise Data System (FEDS) of ERS provide extensive information on costs and returns at various locations. Representative budgets for selected areas and cropping systems in the major States are presented for comparison. The budgets for the Northern Plains and the West are summarized in tables 11 and 12, respectively. The 1975 costs per acre are converted to cost per bushel using 1975 yields.

Table 11--Costs and returns for producing barley in the Northern Plains, 1975 1/

Budget item	Unit	Northern Plains 2/							
		Minnesota		North Dakota		South Dakota		Montana	
		Acre	Bushel	Acre	Bushel	Acre	Bushel	Acre	Bushel
Gross receipts:									
Production	Bu.	35.2		35.5		28.5		38.9	
Price	Dols./Bu.	2.65		2.50		2.20		2.15	
Total receipts	Dols.	93.28	2.65	88.75	2.50	62.70	2.20	83.63	2.15
Production costs:									
Variable costs:									
Preharvest	Dols.	34.24	.97	25.86	.73	23.56	.83	20.26	.52
Harvest	Dols.	4.54	.13	4.95	.14	4.74	.17	6.06	.16
Total variable costs	Dols.	38.78	1.10	30.81	.87	28.30	.99	26.32	.68
Ownership cost:									
Tractors	Dols.	3.90	.11	3.35	.09	1.84	.06	3.26	.08
Machinery and equipment	Dols.	15.88	.45	14.29	.40	10.78	.38	11.15	.29
Total fixed costs	Dols.	19.78	.56	17.64	.50	12.62	.44	14.41	.37
Total costs	Dols.	58.56	1.66	48.45	1.37	40.92	1.43	40.73	1.05
Return to land, overhead, risk, and management	Dols.	34.72	.99	40.30	1.14	21.78	.76	42.90	1.10
Land charge (cash or share rent)	Dols.	26.04	.74	29.88	.84	19.17	.67	25.78	.66
Management charge (7 percent of gross receipts)	Dols.	6.53	.19	6.21	.17	4.39	.15	5.85	.15
Return to overhead and risk	Dols.	2.15	.06	4.21	.12	-1.78	-.06	11.27	.29

1/ Data developed by Firm Enterprise Data System, Commodity Economics Division, Econ. Res. Serv., U.S. Dept. Agr., in cooperation with Oklahoma State Univ., Stillwater, Okla.

2/ Budgets selected for each State are: Minnesota-barley, area 300; North Dakota-barley following crop, area 200; South Dakota-barley following crop, area 200; and Montana-barley following fallow, area 100.

Table 12--Costs and returns for producing barley in the West, 1975 1/

Budget item	Unit	Western States 2/							
		Idaho		Washington		Oregon		California	
		Acre	Bushel	Acre	Bushel	Acre	Bushel	Acre	Bushel
Gross receipts:									
Production	Bu.	67.1		56.9		36.3		68.8	
Price	Dols./Bu.	2.35		2.55		2.55		2.50	
Total receipts	Dols.	157.69	2.35	145.09	2.55	92.57	2.55	172.00	2.50
Production costs:									
Variable costs:									
Preharvest	Dols.	79.19	1.18	39.72	.70	34.50	.95	104.69	1.52
Harvest	Dols.	8.21	.12	3.87	.07	3.41	.09	13.50	.20
Total variable costs	Dols.	87.40	1.30	43.58	.77	37.91	1.04	118.19	1.72
Ownership cost:									
Tractors	Dols.	2.82	.04	2.62	.05	2.92	.08	4.03	.06
Machinery and equipment	Dols.	12.07	.18	19.56	.34	18.93	.52	10.34	.15
Total fixed costs	Dols.	14.89	.22	22.18	.39	21.85	.60	14.37	.21
Total costs	Dols.	102.29	1.52	65.76	1.16	59.76	1.64	132.56	1.93
Return to land, overhead, risk, and management	Dols.	55.40	.83	79.33	1.39	32.80	.90	39.44	.57
Land charge (cash or share rent)	Dols.	76.95	1.15	38.42	.68	30.48	.84	78.00	1.13
Management charge (7 percent of gross receipts)	Dols.	11.04	.16	10.16	.18	6.48	.18	12.04	.17
Return to overhead and risk	Dols.	-32.59	.49	30.76	.54	-4.16	-.11	-50.60	-.74

1/ Data developed by Firm Enterprise Data System, Commodity Economics Division, Econ. Res. Serv., U.S. Dept. Agr., in cooperation with Oklahoma State Univ., Stillwater, Okla.

2/ Budgets selected for each State are: Idaho-barley irrigated, area 400; Washington-barley following crop, area 400; Oregon-barley fallow, area 200; and California-barley irrigated, area 500.

Handling and Storing

Costs for handling and storing grain in commercial warehouses are shown in table 13. Handling at country elevators cost about 5.4 cents per bushel during 1974/75 (truck receiving plus loadout by rail), and annual storage costs averaged about 18 cents per bushel. The average costs of receiving and loading out by rail at terminal facilities were about 5.5 cents per bushel. One year's storage costs were about 17 cents per bushel. Handling costs at port terminals are comparable to inland terminals. Storage costs, however, are significantly higher at an average of 25 cents per bushel, reflecting the greater cost in handling facilities and long-term storage.

Malting

Cost estimates, including annual operating and fixed costs for a 3-million-bushel malthouse, were 31 cents per bushel in 1973 according to a North Dakota study (table 14). Total annual costs for an adjoining 1.5-million-bushel elevator were estimated to be about 11 cents per bushel (3). In 1973, an estimated investment of $7.9 million was required for this malthouse-elevator complex.

Transportation

The costs associated with moving barley and barley products from the production points to consumption locations have increased rapidly in recent years. Since 1967, freight rates have more than doubled. The cumulative effect of various increases, using a base rate of $1, is shown in table 15. There have been specific holddowns, exceptions, or rate reductions on certain commodities in some of the ex parte rate increases. Nevertheless, the information illustrates the dramatic increases that have occurred. Those interested in effective point-to-point rates for barley and malt during 1968 are referred to (2).

INDUSTRY ORGANIZATION AND PRACTICES

The transformation of barley sold by producers into products demanded by users and consumers involves many intermediate marketing firms. These firms are involved in assembly, handling and storing, grading and inspecting, cleaning and scalping, merchandising, and processing. The organization of the industry and the vertical and horizontal relationships among firms involved affect the efficiency of the barley production-marketing process.

Marketing Flows

The flow of barley through the marketing system has been described at various times during the study period. Barley marketing channels were described by Meinken for the 1953 marketing year (14). The trade channels

Table 13--Replacement costs and estimated weighted average cost per bushel for storing and handling grain, fiscal year 1974 1/

Area and type of facility	Received by--			Loadout by--			Storage
	Truck	Rail	Water	Truck	Rail	Water	
				Cents			
North Plains:							
Country	2.32	--	--	1.84	2.24	--	18.35
Inland terminal	1.53	2.68	--	5.48	2.50	1.27	9.81
Port terminal	--	--	--	--	--	--	--
Mid-Plains:							
Country	2.65	2.33	--	3.16	2.94	.71	17.14
Inland terminal	3.07	3.42	--	2.49	2.47	.87	18.73
Port terminal	--	--	--	--	--	--	--
South Plains:							
Country	3.15	--	--	2.62	4.62	--	18.70
Inland terminal	3.18	3.52	--	3.91	2.90	--	26.60
Gulf port terminal	1.43	1.97	1.68	5.55	1.64	.95	26.08
West:							
Country	2.53	--	--	3.28	3.46	--	20.51
Inland terminal	2.29	1.71	--	2.64	1.52	.97	16.67
Port terminal	3.27	2.42	2.55	4.26	3.53	1.39	30.05
Great Lakes:							
Country	2.17	--	--	2.79	3.16	1.74	18.00
Inland terminal	1.98	2.31	6.05	.79	1.93	.34	13.23
Port terminal	2.71	2.43	3.56	3.78	2.81	1.34	23.19
South and East:							
Country	1.53	1.82	4.48	3.36	3.53	1.01	21.77
Inland terminal	2.23	1.78	3.85	3.21	3.26	2.00	11.84
East port terminal	4.00	2.00	3.91	10.87	6.70	2.12	23.54
United States:							
Country	2.39	2.25	4.47	2.76	3.04	1.12	18.18
Inland terminal	2.29	2.97	4.28	2.02	2.49	.90	16.72
Port terminal	2.50	2.19	1.79	6.41	2.84	1.13	25.03
All facilities	2.39	2.50	1.96	2.72	2.88	1.08	18.44

1/ Depreciation and interest on investment based on replacing building and equipment at 1974/75 price levels.

Source: (17).

Table 14--Operating and fixed costs for conventional malthouse, North Dakota location, 1973

Item	Current estimate (annual basis)	Cost/bushel production
	Dollars	
Operating costs:		
Malthouse electrical power	65,000	0.022
Malthouse natural gas	110,000	
Propane standby costs (3 months)	45,000	.052
Labor cost (incl. malthouse, lab, and maintenance lab)	150,000	.050
Repair and maintenance	30,000	.010
Cost of necessary working capital (credit line or cash necessary) for inventory and accounts receivable financing 1/	160,000	.053
Total annual operating costs 2/	560,000	.187
Fixed costs:		
State and local taxes 3/	43,200	.014
Administrative salaries and benefits	75,000	.025
Insurance (inventories, fire, and casualty)	12,000	.004
Annual depreciation 4/	240,000	.080
Total annual fixed costs	370,200	.123
Total annual operating and fixed costs	930,200	.310

1/ Working capital needs are estimated to be $2 million at a rate of 8 percent.
2/ Excludes the cost of an assumed 3 million bushels of barley.
3/ State and local taxes apply only after a potential 5-year tax exemption period. See (2, pp. 33, 56).
4/ Depreciation is computed over a 20-year period on the total cost of the malthouse and auxiliary facilities.

Source: (3).

existing in the early sixties were analyzed by Heid (6) and were estimated for the 1973/74 marketing year by Heid in a more recent publication (7).

The volume moving through various segments or industries involved in the marketing process were estimated for the 1975/76 marketing year and these data are illustrated in figure 2. The arrows represent the major flows between production and alternative end-uses. Other flow possibilities exist that

Table 15--Rail general increases

Tariff	Effective date	Increase	Cumulative rate (base rate $1)	
			Domestic	Export
		Percent	Dollars	
Ex Parte 256	8/19/67	3	1.03	1.03
Ex Parte 259-B	11/28/68	5	1.08	1.08
Ex Parte 262	11/18/69	6	1.14	1.14
Ex Parte 265-B	11/20/70	6	1.21	1.21
Ex Parte 267-B	4/21/71	Approx. 8	1.31	1.31
Ex Parte 281-B	10/23/72	Approx. 5	1.38	1.38
Ex Parte 295-A	8/19/73	3	1.42	1.42
Ex Parte 299-A	3/16/74	2.8	1.46	1.46
Ex Parte 302	2/26/74	10		
	(Grain export only)	(6¢ max.)	1.46	1.52
Ex Parte 303-A	3/ 9/74	4	1.52	1.58
Ex Parte 305-A	6/20/74	3.3	1.57	1.63
		10	1.73	1.79
Ex Parte 310-A	4/27/75	7	1.85	1.92
Ex Parte 313	6/20/75	5	1.94	2.02
	10/ 1/75	2.5	1.99	2.07
Ex Parte 318	3/21/76	7.0	2.13	2.21
		(East & South only)		
Ex Parte 330	10/ 7/76	5.0	2.09	2.17
		(West only)		

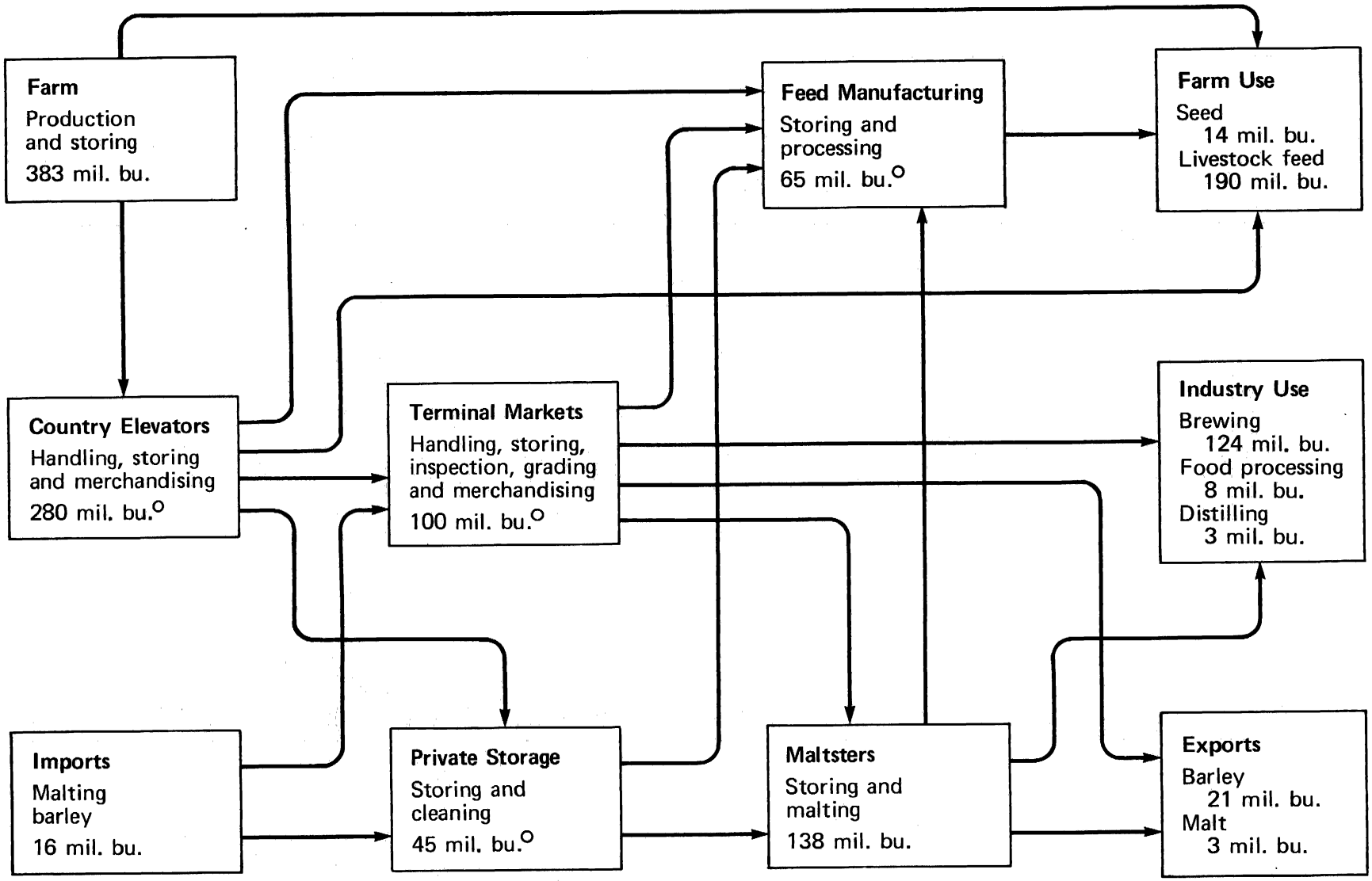
Source: (28).

bypass country elevators; however, these are relatively small and are not shown. The flows indicated relate to the institutions or industries physically handling barley or using barley products.

Producer Sales

Although most of the barley sold by producers moves to country elevators, other marketing patterns have developed that are not shown in figure 2. Direct sales to feed manufacturers, terminal market firms, and maltsters account for a small percentage of off-farm sales each year. The predominant movement is to country elevators, and this volume includes sales to country elevators and quantities produced under contract for maltsters. The contract quantity

Estimated barley marketing flows, 1975/76 marketing year



°*Estimated from industry sources.*

Not shown in this illustration is the beginning inventory of 92 million bushels and the ending inventory of 129 million bushels. These volumes tend to be scattered throughout the marketing chain at any given point in time either as stored barley, barley products, or working inventories.

Figure 2

has accounted for up to one-sixth of the volume handled by country elevators in recent years.

Harvest of winter barley begins in late May in the South and Southwest, and ends in September with the harvest of spring barley in the Northwest. Farm sales have traditionally been greater at harvest; however, they are usually spread throughout the crop marketing season.

Seasonal marketing patterns have undergone change in recent years. The most notable change occurred in sales at harvesttime, with summer (harvesttime) sales declining from about one-half to about two-fifths of total sales since the midsixties. In 1974/75, summer and fall sales increased significantly compared to the previous 2 years. This change reflects a response to higher than average farm prices that existed during the summer and fall of that year (see table 9).

The shifts in the seasonal distribution of farm sales that occurred in the last 10 years indicate that producers are placing more emphasis on marketing, and are attempting to take advantage of seasonal variations in price. Thus, farmers are increasingly participating in the storage function of marketing, and benefit from the substantial seasonal price variation that has been occurring during the seventies.

The changing sales pattern is probably also related to the increased use of production contracts with maltsters. To the extent that these contracts call for delivery at a time other than harvest they would have the effect of spreading reported sales throughout the marketing season. Contracting with producers started in the West in the early sixties by malt companies interested in two-rowed barley. An estimated 90 percent of some two-rowed varieties are contracted. Overall, contracts currently account for about one-third of all maltsters requirements. This procurement practice will likely increase in the future, and may become a common practice in the Northern Plains where six-rowed malting varieties are grown if current emphasis on wheat production continues.

Contracts may also be initiated by a barley merchandiser. The merchandiser serves as an alternative market outlet for growers, and serves maltsters by obtaining the quality and quantity of barley desired. Merchandisers take orders from maltsters, make contracts with producers, take title to the barley at harvesttime, and direct the delivery from the country elevator to the maltster. One merchandiser may service several maltsters. Merchandisers compete with one another as well as with large grain companies and fieldmen of grain processors in contracting malt barley.

Although contracting is important in establishing an orderly marketing pattern, the influence of a large or small carryover appears to be dominant. This fact was quite evident in 1974/75. When the supply decreased, the percentages of summer off-farm sales increased sharply.

Assembly

Barley production is dispersed over a wide geographical area, with each production unit contributing a relatively small volume of total supply. Consequently, the grain must be assembled into economical units prior to shipment to processors, terminal markets, and other users. This function is performed primarily by country elevator operators.

A large proportion of country elevator receipts are purchased by the elevator owner. In addition, most of the barley grown under contract with maltsters and merchandisers is handled by country elevators before shipment to intermediate holding facilities owned by maltsters. The remainder is sold directly to terminal elevators, feed manufacturers, and maltsters. The volume bypassing country elevators has not increased in recent years. However, with large farmers and maltsters building or purchasing storage facilities in major producing areas, the volume bypassing country elevators may increase in the future.

Storage

Storage is a necessary function of marketing in the movement of malting barley for three reasons. First, it is important to keep malting-quality barley segregated from feed barley. Second, an orderly flow of malting barley is necessary. And, third, it is usually desirable to store new-crop barley at least 4 months before malting to assure kernel dormancy before the malting process is commenced.

Storage of barley, required at some point in the marketing channel, is shared by farmers, country elevator operators, terminal and subterminal operators, and maltsters. A large proportion of the barley marketed in the United States is stored on producing farms for a part of the year. Barley that is sold from the farm later in the marketing year may be stored for a period of time by country elevators. That marketed at harvesttime is usually moved to terminal elevators for storage if it is not used immediately.

Once malting barley leaves country elevators, it is shipped to terminal elevators or private storage facilities owned by maltsters where it is graded, cleaned, blended, and stored until it is shipped to malting plants. The barley receipts at intermediate storage facilities and receipts at malt plants from terminals are "high graded." In this process, about 10 percent of the lower quality malting barley is sorted out and sold to prepared feed manufacturers.

Terminal markets continue to be an important channel in the barley marketing system. However, receipts at major grain centers have declined during the seventies. Terminal elevators located at Minneapolis and Milwaukee are the main inland terminal locations for handling and storage. Terminals at Duluth-Superior and on the Columbia River handle a large share of exports. Most of the barley actually handled by inland terminals is later channeled to maltsters, feed manufacturers, and exporters. Barley channeled to maltsters

and other industrial users is often moved through terminal facilities for inspection only. Uncommitted barley arriving at terminal markets is sold either on track on a delivered basis, on to-arrive contracts, or on consignment to commission houses at the terminal. Most receipts are graded and offered for sale to the highest bidder. Bidders are generally feed manufacturers, exporters, or barley processors filling their current needs. Sales are usually made on a flat price based on a standard or specified grade. Any variation from the specified grade is settled between buyer and seller at a later date through price premiums and discounts.

Since most of the barley sold by farmers moves through country elevators, it must compete with other grains produced in the same area for available storage space. The grain storage capacity of facilities in major barley production-marketing States is shown in table 16 by type of facility. The capacity data for country and terminal warehouses include all warehouses that have a Uniform Grain Storage Agreement (UGSA) with the CCC. Most commercial warehouses that store grain have an agreement with CCC. The capacity designated as private storage is generally attached to flour mills, feed manufacturing plants, barley malting plants, oilseed crushers, and other grain processing facilities.

Table 16--Grain storage capacity of country, terminal, and private storage facilities in major barley production-marketing States, January 1977

State	Country elevators 1/	Terminal elevators 1/	Private storage 2/	Total capacity 3/
		1,000 bushels		
Wisconsin	8,016	41,518	69,466	119,000
Minnesota	159,531	148,786	47,173	355,490
North Dakota	118,702	16,261	6,137	141,100
South Dakota	73,295	2,242	7,893	83,430
Montana	38,285	4,420	8,515	51,220
Colorado	44,299	12,759	35,542	92,600
Idaho	45,066	732	13,552	59,350
Washington	122,984	39,197	13,319	175,500
Oregon	37,581	14,594	11,895	64,070
California	23,179	18,768	67,273	109,220
Total	670,938	299,277	280,765	1,250,980

1/ Capacity of warehouses operating under a Uniform Grain Storage Agreement with the CCC.
2/ Off-farm storage capacity not covered by a storage agreement with CCC.
3/ Rated off-farm storage capacity as reported by the Stat. Rptg. Serv., U.S. Dept. Agr.

Inspection and Grading

Trading barley in the United States is facilitated by inspection and grading services performed either by Federal or State grain inspection agencies. As noted above, barley is often shipped to terminal markets for inspection, and then diverted to buyers who purchase the carlots on the basis of the designated grades. When barley is sold, official inspection is required under the United States Grain Standards Act.

The classification of barley as presented in the Official United States Standards for Grain (27) is illustrated in figure 3. Barley standards were revised effective November 1, 1976, at which time the western barley class was eliminated.

Six-rowed barley is any barley of the six-rowed type with white hulls which contain not more than 10 percent of two-rowed barley or black barley, either singly or combined. Two-rowed barley is any barley of the two-rowed type with white hulls which contain not more than 10 percent of the six-rowed barley or black barley, either singly or combined. Barley is any barley which does not meet the requirements for either of the other two classes, or which contains more than 10 percent of black barley. The major distinction separating the two types of six-rowed malting barley is the percentage of kernels by color of the aleurone layers. Six-rowed blue malting barley has 90 percent or more of the kernels with blue aleurone layers (outer protein layers). Six-rowed malting barley has at least 90 percent white aleurone layers.

The 1976 revision of barley standards strongly reflects the importance of malt barley to the industry. However, protein--a very important quality factor used by the trade--is still not considered in the official grades and standards.

Processing

Processing is a very important marketing function for barley. Maltsters, mixed feed manufacturers, and brewers are the major processors of barley and barley malt. Food processors and distillers are of less importance as users.

Maltsters

Maltsters utilize malting barley to produce malt. The malting process involves sprouting of the kernels which converts the starch content to a form of sugar. Malt is a food product; however, a major proportion of the malt produced in the United States is used in the production of alcohol and alcoholic beverages.

All malting barley receipts must be graded and thoroughly cleaned. Cleaning removes all foreign materials and thin and cracked kernels, and insures uniform kernels for sprouting. A 98 percent or better germination is desirable. These processes of cleaning and grading may take place at either

Barley classes, subclasses, and special grades

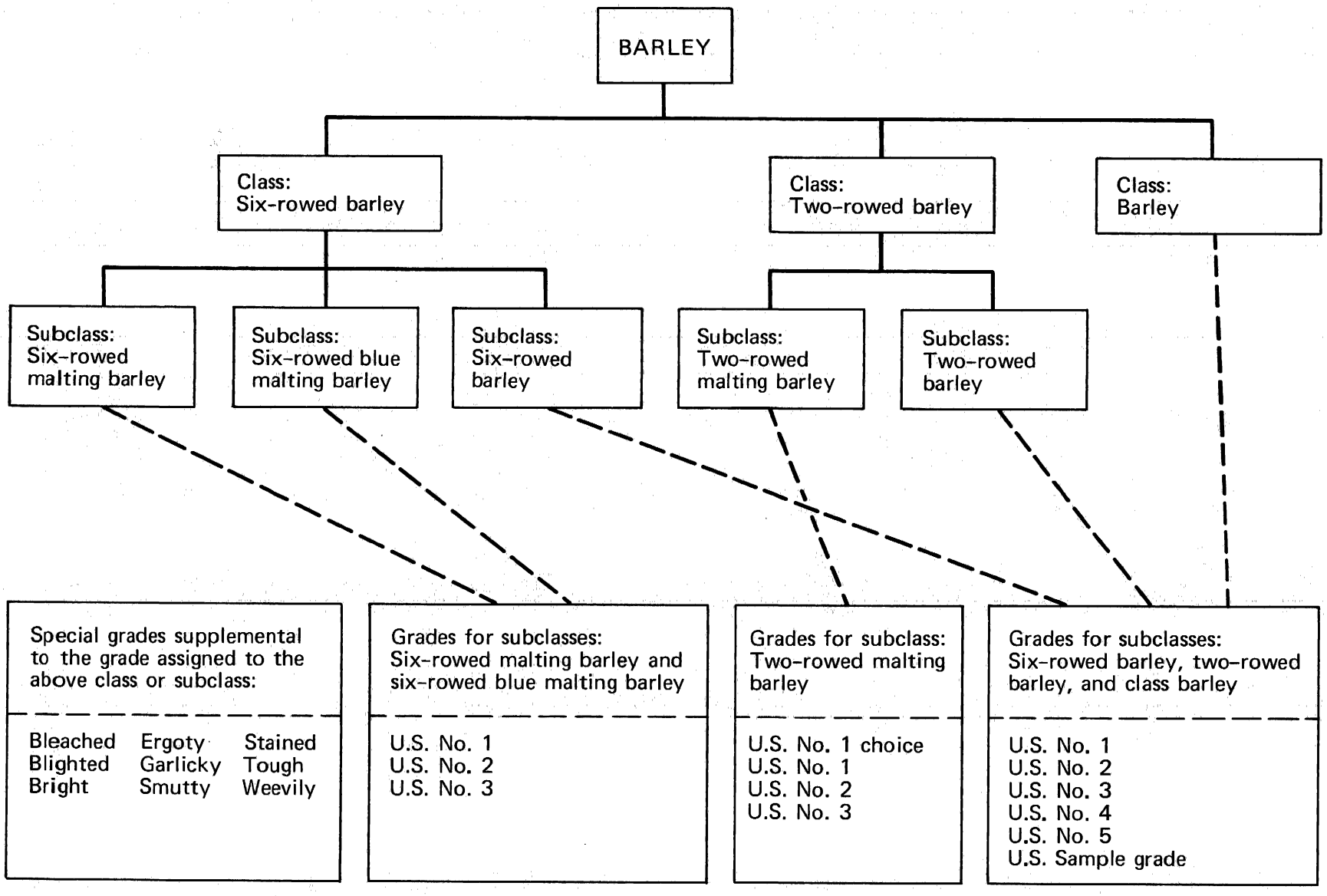


Figure 3

the terminal elevator, an intermediate storage location, or a storage facility adjacent to the malt house.

The clean barley is malted and the malt is placed in storage 4-8 weeks for aging. It is then shipped to brewers, distillers, food processors, and export destinations.

During the study period, the industry expanded capacity as the demand for malt increased. However, the number of companies and plants in operation declined significantly. Currently, about 30 companies operate about 40 malt plants, compared to 1953 when 44 firms operated 56 plants (1). Many companies that operated small plants during the early fifties went out of business. Several of those remaining in the industry have increased capacity by purchasing other plants or constructing new malting facilities. A large proportion of the expansion in capacity that occurred during the sixties involved firms other than the large ones. Between 1958 and 1967, the concentration ratio for the four largest companies declined from 50 to 39 according to Census of Manufactures reports (31). Concentration ratios were not available for the 1972 census year; however, trade estimates for the early seventies indicate about 50 percent of the malting business was performed by the four largest firms, none of which is a brewer-maltster (33).

The industry is becoming more vertically integrated with the construction or acquisition of malting houses by major brewing companies. Such activity will reduce the proportion of total output accounted for by the four largest firms. Increases in the malting capacity owned by brewers will likely lead to increased use of barley production contracts by these integrated firms.

Data on malting capacity throughout the study period are not available. However, a technical assistance study conducted under contract with the Economic Development Administration (2) developed estimates of malting capacity for 1968. Over three-fourths of total malting capacity was located in Illinois, Minnesota, and Wisconsin. Most of this capacity was centered in Chicago, Minneapolis, and Milwaukee. The industry has grown since 1968, primarily through plant expansion, at an annual rate of approximately 3 percent. Most of the capacity expansion appears to have taken place in Colorado, Wisconsin, Illinois, Minnesota, Washington, and California.

Prepared Animal Feed Manufacturers

Prepared animal feed (PAF) manufacturing industry ranks second behind maltsters as a barley processor. The PAF industry purchases barley from farmers, country elevators, and terminal elevators. It also purchases low-quality barley, rootlets, and brewers' dried grains from maltsters and brewers.

In 1969, 3,164 feed manufacturing establishments used about 102 million bushels of barley in the production of animal feeds. Barley represented about 7.5 percent of total grain tonnage used by the industry in 1969 (9, p. 17). Of the 250 million bushels of barley used for livestock feed in 1969, about 46 percent was used on farms where produced, 41 percent was processed by the

feed manufacturing industry, and 13 percent moved back to the farm as whole grain.

In 1975/76, 103 million bushels, or 54 percent of the total used for livestock feed, was fed on farms where produced (table 1). Assuming that about three-fourths of the balance was processed by feed manufacturers (the same proportion as 1969), the volume used by the industry would have been about 65 million bushels. The other 22 million bushels of the 190 million total would have moved back to livestock farms as whole grain.

In general, barley is used by feed manufacturing establishments located near barley production locations. In 1969, the weighted average distance of establishments from principal suppliers of barley was 229 miles. The Mountain and Pacific regions are major feed-barley production areas. Feed plants in those regions accounted for almost 74 percent of the total quantity used by the industry. Feed plants in California accounted for almost one-third of the total feed industry use in 1969.

During that year, the industry shipped about 98 million tons of formula feed (9, p.42). About 89 percent of this was shipped by truck for an average of 39 miles. Rail shipments moved an average of 210 miles, but accounted for only 11 percent of the volume. The shipments of feed by modes of transportation and distance are summarized for 1969:

Mode	Shipments	Distance
	1,000 tons	Miles
Rail	10,423	210
Truck:		
Company-owned	56,650	31
Customer-owned	23,193	38
All other	7,247	114
Total truck	87,090	39

The feed industry was heavily involved in the distribution of formula feed, with company-owned trucks accounting for about 58 percent of total shipments. In the Pacific region where barley is used extensively by the industry, company-owned trucks delivered 80 percent of the formula feed produced in 1969 (9, p. 42).

Brewing

The brewing industry is the major user of malt produced in the United States, and about 90 percent of the malt output moves to brewers. Corn grits and brewers rice are the other grain products used by the industry. Barley

malt is the brewer's most important grain product, and accounts for about two-thirds of the total use of grain and grain products by the industry.

After several years of stability in sales, the brewing industry began a period of rapid growth in sales in 1958 (table 6). By 1975, industry sales had increased from 84 million barrels to about 147 million, an increase of 75 percent. The rapid increase in industry sales was accompanied by a tremendous increase in concentration in the industry. Large brewers accounted for a major portion of plant construction and expansion, and the market share of the top five increased from about 28 percent in 1957 to 67 percent in 1975. During the same period, the top 10's market share increased from 45 percent to 85 percent. The preliminary data for 1976 indicate a continuation of this trend, with these firms gaining an additional 1 percent of the market.

The increase in market share of the larger brewers, and the associated increase in industry concentration, has had implications for the smaller breweries. Approximately 3 out of 4 breweries that were in business in 1950 had left the industry by 1974 (table 17). Many of the breweries leaving the industry were family operated firms with annual plant capacities of 100,000 barrels or less. These breweries closed primarily because of size diseconomies, and many lacked the financial strength to expand operations or to compete with the larger firms.

Table 17--Breweries operating in selected years, and 1974 production of malt beverages by census region

Region	Breweries in operation				1974 production
	1950	1960	1970	1974	
	Number				1,000 barrels
North Atlantic	122	62	45	34	28,999
East North Central	151	75	45	21	38,112
West North Central	35	24	16	10	17,049
South Atlantic	23	17	13	15	21,072
South Central	21	16	13	13	19,230
Western	55	38	22	18	28,591
United States	407	229	154	111	153,053

Source: (20).

Unlike the malting industry, the closing of so many breweries has not resulted in a spatial concentration in the brewing industry. The large brewers are building plants near major consumption areas. This tendency is due mainly to increasing freight rates and the trend toward returnable

bottles. Also, whereas barley accounts for around 85 percent of the cost of materials in the malting industry, barley malt accounts for only about 15 percent of the materials purchased by the brewing industry. With 85 percent of the brewers' input items (containers are one of the largest cost items) being other than malt, plant location is based largely on nonmalt procurement considerations.

POLICY

U.S. agriculture has been influenced by Government farm programs since the thirties when legislation was passed to reduce production and support farm prices. Since 1950, the main features of feed grain programs that have affected barley involve price supports (through nonrecourse loans from CCC), acreage diversions, and set-aside programs.

During the study period, price supports were mandatory for corn, wheat, and rice. Oats, barley, rye, and sorghum were included in the "permissive" price support category under which support could not exceed 90 percent of parity. In the Agricultural Act of 1956, barley, oats, rye, and sorghum were included as designated nonbasic commodities. Price support was mandatory on the 1956 crop at 76 percent of parity, and on the 1957 crop at not less than 70 percent of parity.

The Agricultural Act of 1958 took barley out of the "permissive" price support category, and required that with the 1959 crop, price support should be made available at a level determined by the Secretary of Agriculture to be fair and reasonable in relation to the level of support made available for corn. Since support for corn was and still is mandatory, this had the effect of also making support mandatory for barley.

During the sixties, barley was generally included in programs for feed grains that included price support at not less than 65 percent of parity. Acreage diversion programs were used extensively during this period under which producers received payments for diverting acreage from feed grains to conserving uses. Barley was included as a diverted acre crop for 1962. The feed grain programs throughout the sixties generally utilized acreage diversion provisions as the means of controlling production.

The Agricultural Act of 1970 initiated a cropland set-aside approach for participating producers of feed grains. This was a voluntary feed grain program (corn, sorghum, and, if designated by the Secretary of Agriculture, barley) for the 1971-73 crop years. Under the set-aside program, participating farmers were required to set aside feed grain acreage or other cropland in order to become eligible for loans and payments. Barley was not designated for the program in 1971, but was included in 1972 and 1973.

The Agriculture and Consumer Protection Act of 1973 continued the Secretary's authority to establish cropland set-aside (and additional diverted acreage). This legislation established target prices and disaster coverage for feed grains, with payments to eligible producers based on allotted acres. Deficiency payments were provided if the average market price received by

producers during the first 5 months of the marketing year dropped below the target level. The payments equalled the difference between the target price and the higher of the loan level or the average market price. The target prices for barley were set in relation to the rate for corn. This Act covered the 1974-77 crop years.

The Food and Agriculture Act of 1977 assures feed grain producers of continued target price protection for 1978-81, and disaster coverage for 1978-79. Included are corn, grain sorghum, and (if designated by the Secretary of Agriculture) oats and barley. Program benefits are based on planted acres for harvest rather than allotted acres.

Price Support Operations

Barley producers have enjoyed a degree of price protection for their production throughout the study period through the price support operations of CCC. The nature of the support price has varied since 1950, and in recent years has consisted of a loan rate plus support payments. Eligibility for loans and support payments generally requires producers to comply with the provisions of the feed grain program in effect at a particular time.

The loan rate component gives the producer the option of placing his barley in CCC-approved farm or commercial storage as collateral for a loan from CCC. The amount of the loan is based on the local loan rate established by CCC, and is subject to premiums and discounts based on grain quality. The national average support prices in effect for each crop since 1950 are shown in table 18. Prior to 1963, the support price was strictly a loan rate. Beginning with the 1963 crop, barley has also been included in the feed grain program for support payments, with the exceptions of 1967, 1968, and 1971. The 1965 and 1966 programs contained special provisions for malting barley producers which are noted in table 19.

The quantities of each crop placed under price support (nonrecourse loans and purchase agreements) since 1950 are also shown in table 19. Producer participation was very high in the late fifties, and a record 142 million bushels of the 1957 barley crop, almost one-third of total production, were placed under price support. Quantities placed under price support were significantly larger in the 3 years when producers did not receive support payments in addition to the basic loan rate. The rapidly declining quantity placed under price support since the crop of 1971 reflects higher market prices. Less than 10 million bushels of the 1974 and 1975 crops were placed under loan with CCC.

The national average loan rate for barley was increased to $1.22 per bushel for the 1976 crop. A rate of $1.50 per bushel is under consideration for the 1977 crop. The national average rate for barley is usually set in relation to the loan rate for corn. Thus, the increases reflect increases that are occurring in the loan rates for corn.

Once barley is placed under price support, the producer has several options. First, he can redeem his loans by repaying CCC and then market the barley in the usual manner. This option is usually chosen when market prices

Table 18--Barley: Price support operations

Crop year	National average support price			Quantity under price support			Percent under support
	Loan rate	Support payment	Total	Loans	Purchase agreements	Total	
	Dollars per bushel			Million bushels			Percent
1950	1.10	0	1.10	29.6	1.0	30.6	10.1
1951	1.11	0	1.11	16.3	.6	16.9	6.6
1952	1.22	0	1.22	7.5	2.4	9.9	4.3
1953	1.24	0	1.24	36.1	9.1	45.2	18.3
1954	1.15	0	1.15	100.8	14.3	115.1	30.4
1955	.94	0	.94	78.5	17.5	96.0	23.8
1956	1.02	0	1.02	63.5	13.6	77.1	20.5
1957	.95	0	.95	119.3	22.9	142.2	32.1
1958	.93	0	.93	86.9	20.4	107.3	22.5
1959	.77	0	.77	33.9	6.9	40.8	9.7
1960	.77	0	.77	43.1	6.6	49.7	11.0
1961	.93	0	.93	42.9	1.3	44.2	11.3
1962	.93	0	.93	33.2	6.7	39.9	9.3
1963	.82	.14	.96	23.7	4.5	28.2	7.2
1964	.84	.12	.96	15.0	1/	15.0	3.9
1965	.80	.16	2/.96	16.5	1/	16.5	4.2
1966	3/.80	.20	1.00	16.5	1/	16.5	4.2
1967	.90	0	.90	47.8	.4	48.2	12.9
1968	.90	0	.90	116.2	7.6	123.8	29.3
1969	.83	.20	1.03	52.0	.5	52.5	12.4
1970	.83	.20	1.03	27.5	.1	27.6	6.7
1971	.81	0	.81	88.9	1/	88.9	19.2
1972	.83	.32	1.15	41.7	1/	41.7	9.9
1973	1.08	.26	1.34	15.3	1/	15.3	3.6
1974	.90	.23	1.13	6.9	1/	6.9	2.3
1975	.90	.23	1.13	8.0	1/	8.0	2.1

1/ Less than 500,000 bushels.
2/ Malting barley on exempted farms--price support loan 96 cents--no support payments.
3/ Malting barley producers electing the exemption would receive no price support payment but would receive an additional payment of 12.5 cents a bushel.

Source: (23), (25).

Table 19--Barley: Disposition of quantities placed under price support

Crop year	Total placed under price support 1/	Redeemed by farmers 2/	Delivered to CCC	Resealed	Total deliveries to CCC 3/
			Million bushels		
1950	30.6	27.1	3.5	4/	3.5
1951	16.9	14.7	2.2	4/	2.2
1952	9.9	7.3	2.6	4/	2.6
1953	45.2	13.0	28.1	4.1	32.4
1954	115.1	24.8	84.8	5.5	94.4
1955	96.0	23.3	72.7	4/	77.2
1956	77.1	16.7	53.4	7.0	64.4
1957	142.1	23.7	101.2	17.2	121.9
1958	107.3	37.2	45.3	24.8	69.9
1959	40.8	26.5	4.9	9.4	8.7
1960	47.3	24.4	10.4	12.5	16.9
1961	44.2	30.0	9.5	4.7	14.0
1962	39.9	10.6	16.8	12.5	26.3
1963	28.2	16.2	2.7	9.3	3.7
1964	15.0	11.8	.2	3.0	.3
1965	16.5	12.5	5/	4.0	1.8
1966	16.5	10.5	5/	6.0	2.5
1967	48.2	18.8	.8	28.6	17.0
1968	123.8	38.0	38.3	47.5	70.0
1969	52.5	22.1	4.1	26.3	5.6
1970	27.6	19.1	.6	7.9	.9
1971	88.9	59.6	.7	28.6	.7
1972	42.4	42.4	--	4/	--
1973	15.3	15.3	--	4/	--
1974	6.9	6.9	--	4/	--
1975 6/	8.0	8.0	--	4/	--

1/ Placed under loan and purchase agreement through 1963; under loan and deliveries to CCC from purchase program beginning 1964.
2/ Residual; grain on which loans are repaid.
3/ Includes deliveries from original program, from reseal program and "over-deliveries."
4/ Loans were not extended.
5/ Less than 500,000 bushels.
6/ Preliminary.

Source: Agricultural Stabilization and Conservation Service, U.S. Dept. Agr.

rise above loan levels. Second, he can forfeit the loans and deliver the barley to CCC. If the barley is stored on-farm, the producer must deliver the grain to a CCC-approved commercial warehouse. The warehouseman issues a warehouse receipt indicating the quantity and quality delivered, and a final settlement between the producer and CCC is made on the basis of the warehouse receipt. A third option, the re-seal loan program, was available in most years prior to 1972 under which producers could extend CCC loans on barley for an additional year. This option provided producers additional flexibility under the price support program. The CCC also paid the storage charges for grain covered by an extended loan. Thus, the expense to producers was limited to grain ownership costs reflected by the CCC loan interest rate.

The options exercised by producers over the years are reflected in table 19. Total deliveries to CCC reached a record high of 122 million bushels for the 1957 crop. In the late fifties, surpluses and depressed market prices were quite common. Even though program participation has been significant in some years during the seventies, almost all loans have been redeemed by producers and deliveries to CCC were less than 2 million bushels for the 6 crop years combined.

CCC Merchandising Operations

The final aspect of Government programs for barley is related to CCC's inventory management and merchandising operations. CCC-owned stocks of barley reached a record high of 97 million bushels in July 1959. Of this total, 20 million bushels were stored in CCC-owned binsites. Binsite storage was used extensively in the late fifties and early sixties. Currently, CCC utilizes commercial facilities entirely for storage of CCC-owned grains. Following the 1959 peak, the barley stocks owned by CCC declined to about 6 million bushels by 1967. Stocks later increased due to farmer deliveries of loan barley from the 1967 and 1968 crops which were not covered by acreage controls and support payments.

The stocks acquired by CCC through price support operations were disposed of through various sales programs. Restricted export sales, the predominant outlet for CCC stocks during the study period, accounted for 491 million bushels, or about 79 percent of the total CCC barley sales. Unrestricted domestic sales exceeded sales under various export programs in only 3 years, and total only 131 million bushels since 1954 when data became available. Sales by CCC under various export programs appear to be a major factor associated with the variation in barley exports (table 4). These sales have varied from a high of 91 million bushels in 1955 to zero in the seventies. Export sales have predominated in most years due to favorable minimum sales prices on restricted export sales. Programs such as P.L. 480 also played a role in making barley and other grains available to importing nations on very favorable terms.

Variations in farm deliveries to CCC (table 19) and in CCC-owned stocks reflect producer response to changes in the support price/market price relationship. When large supplies depress market prices to loan-rate levels, the CCC becomes an important outlet for the surplus grain. The loan program also

becomes an important source of interim financing for producers who hold their grain for anticipated higher market prices.

Government programs had a minimal influence on barley production and marketing during the last 4 years of the study period. The main influence was the indirect, adverse impact of increased wheat prices and acreage. However, barley supplies and demands appear to be balanced at the present time, with carryover running about 100 million bushels.

WORLD PRODUCTION AND TRADE

Barley is probably grown in more countries than any other grain. This reflects the climatic adaptability of barley. A few countries use barley primarily for food; however, it is used for both food and livestock feed in most countries.

The increasing importance of barley in the world grain economy is best illustrated by considering the area seeded to various grain crops. The area seeded to all grain crops has increased from 602 million hectares (1 hectare equals 2.471 acres) in 1950 to 732 million hectares in 1975, an increase of over 21 percent. This increased area plus a 63-percent increase in average yields has resulted in a 98-percent increase in total grain production since 1950. In 1975, per capita world grain production was 344 kilograms compared to 276 kilograms in 1950, with barley representing over 10 percent of total production.

Barley accounted for 85 million hectares in 1975, an increase of 38 million hectares since 1950. The increase in barley area was exceeded only by wheat, which increased 52 million hectares and accounted for almost 31 percent of the total grain area. The area seeded to rye and oats has declined significantly, a trend that has also occurred in the United States. In fact, about one-half of the decline in the area seeded to oats is accounted for by U.S. acreage reductions. Barley area surpassed oats during the 1950-76 study period to rank fourth behind wheat, rice, and corn, and accounts for almost 12 percent of the total world grain area.

World Production

Although barley is grown throughout the world, production is concentrated in the northern latitude (fig. 4). Since 1950, world production tripled, with most of the increase occurring in Europe. Eastern and Western Europe accounted for about 65 percent of the world production in 1975, up from 38 percent in 1950. During the same period, North America's share declined from 19 to 13 percent, and Asia's share declined from 34 to 16 percent.

The actual production in each of the seven world regions since 1950 is shown in table 20. During the period, production in Eastern Europe increased 368 percent with the U.S.S.R. accounting for about three-fourths of that increase. The U.S.S.R. had severe weather problems in 1975 with production

World barley production, 1950 and 1975

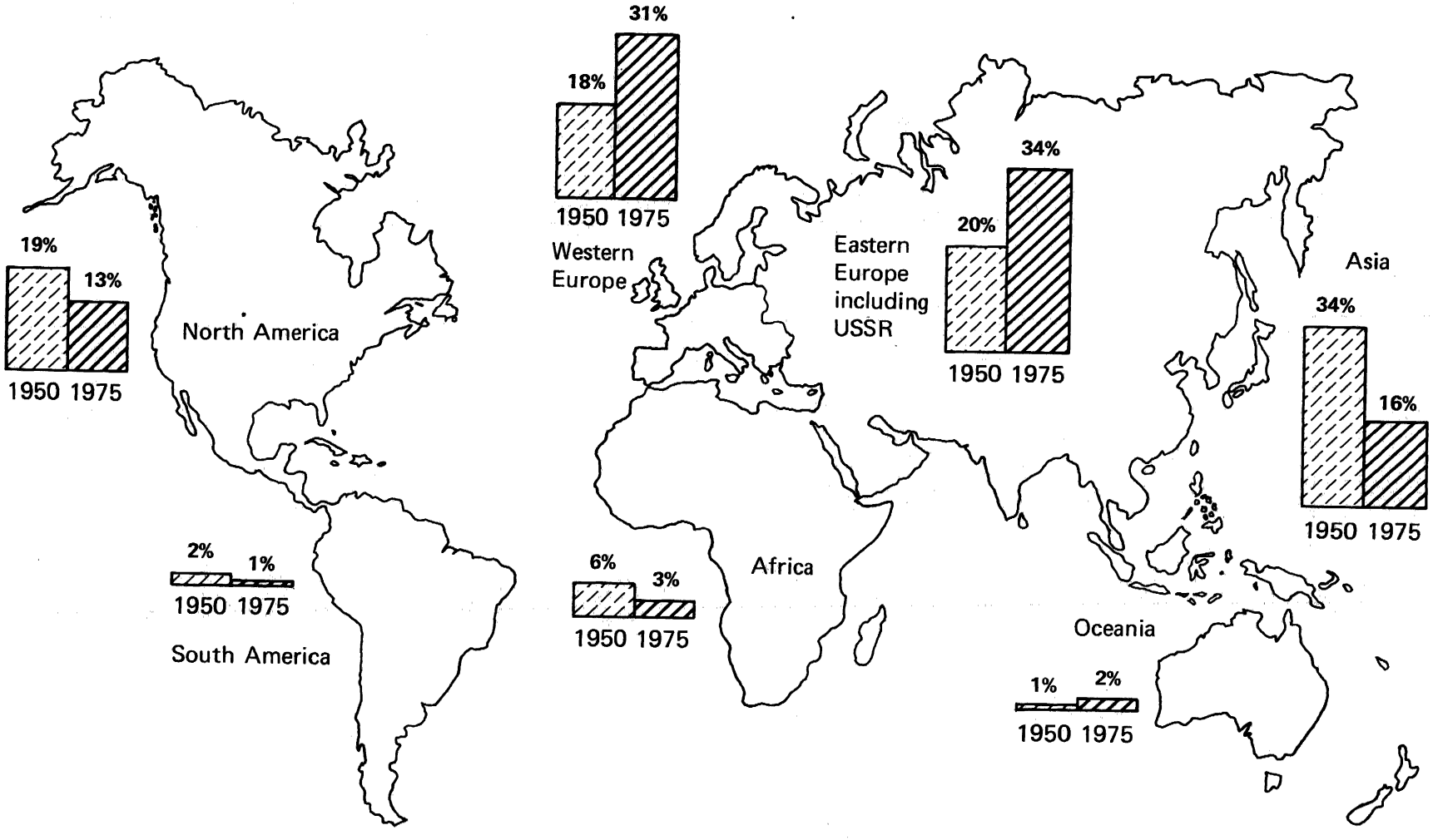


Figure 4

Table 20--World barley production

Year	North America	South America	Africa	Asia	Oceania	Eastern Europe	Western Europe	Total
				Million metric tons				
1950	10.4	1.2	3.4	18.0	0.6	10.6	9.9	54.1
1951	11.1	.8	3.5	18.3	.5	10.2	11.4	55.9
1952	11.5	1.7	4.1	19.3	.8	13.5	12.6	63.5
1953	11.2	1.5	4.0	20.9	1.0	13.4	13.4	65.5
1954	12.2	1.7	4.4	20.9	.7	12.3	13.5	65.7
1955	14.4	1.5	3.4	20.2	1.0	15.9	14.3	70.8
1956	14.3	1.9	4.1	20.9	1.2	17.9	18.7	79.0
1957	14.5	1.5	2.8	22.1	.8	14.4	16.9	73.0
1958	15.7	1.6	4.0	19.8	1.5	18.3	17.2	78.2
1959	14.0	1.7	3.5	18.8	.8	16.4	19.8	75.1
1960	13.7	1.4	3.9	19.6	1.6	22.9	21.6	84.6
1961	11.2	1.4	2.4	19.6	1.0	19.8	22.0	77.4
1962	13.1	.9	3.9	22.1	1.0	26.4	25.4	92.8
1963	13.6	1.6	4.3	21.0	1.1	26.5	28.0	95.7
1964	12.2	1.4	3.5	20.3	1.2	35.3	29.0	102.9
1965	13.5	1.0	3.6	21.4	1.1	27.9	30.2	98.6
1966	15.3	1.0	2.5	21.0	1.5	35.6	31.8	108.8
1967	13.8	1.2	3.4	20.9	1.0	33.0	37.3	110.7
1968	16.6	1.2	5.9	22.1	1.9	37.4	37.5	122.6
1969	17.6	1.1	4.5	20.9	1.9	42.0	38.9	127.0
1970	18.2	1.0	4.4	20.0	2.5	47.2	35.6	128.8
1971	23.4	1.1	4.8	20.4	3.3	45.5	41.6	140.0
1972	20.8	1.5	5.2	21.1	2.1	48.4	43.6	142.6
1973	19.8	1.3	3.6	18.5	2.7	67.7	44.4	157.8
1974	15.7	1.1	4.5	20.0	2.8	69.2	46.8	160.2
1975	18.2	1.2	4.0	22.5	3.5	49.6	44.9	143.9

Source: (29).

declining 18.4 million metric tons. The area seeded to barley in the U.S.S.R. was up by 1.5 million hectares in 1975; however, average yield dropped from 1,744 to 1,099 kilograms per hectare, a 37-percent decline.

The U.S.S.R. led all other countries in total production since the mid-fifties, and accounted for over one-third of world production in 1973 (table

21). In 1975, the United States ranked sixth in production, down from second in 1970. Four of the top producing countries are located in Western Europe, a region which accounted for almost a third of world production in 1975. The People's Republic of China is the leading barley producer in Asia, a region with fairly stable production since 1950. The countries included in table 21 currently produce about two-thirds of the world's annual barley output.

Table 21--Barley production in selected countries

Year	United States	Canada	United Kingdom	France	Spain	West Germany	U.S.S.R.	People's Republic of China
				Million metric tons				
1950	6.6	3.6	1.7	1.6	1.5	1.5	6.4	7.9
1951	5.6	5.3	2.0	1.7	2.2	1.7	5.2	8.0
1952	5.0	6.3	2.4	1.7	2.2	1.8	8.7	8.1
1953	5.4	5.7	2.6	2.2	1.5	2.1	7.9	8.2
1954	8.3	3.8	2.3	2.5	2.2	1.9	7.8	8.3
1955	8.8	5.5	3.0	2.7	1.7	2.1	10.4	8.4
1956	8.2	5.9	2.8	6.4	1.6	2.3	12.9	8.6
1957	9.6	4.7	3.0	3.6	1.9	2.5	8.5	8.7
1958	10.4	5.2	3.2	3.9	1.8	2.4	13.0	7.9
1959	9.1	4.7	4.1	4.9	2.1	2.8	10.2	6.5
1960	9.3	4.2	4.3	5.7	1.6	3.2	16.0	6.9
1961	8.5	2.5	5.1	5.4	1.7	2.7	13.3	7.4
1962	9.3	3.6	5.9	6.0	2.2	3.7	19.5	8.6
1963	8.6	4.8	6.7	7.4	2.1	3.6	19.8	9.1
1964	8.4	3.7	7.5	6.8	1.9	3.9	28.6	9.3
1965	8.6	4.8	8.2	7.4	1.9	3.4	20.3	9.1
1966	8.5	6.6	8.7	7.4	2.0	3.9	27.9	9.1
1967	8.1	5.5	9.2	9.9	2.6	4.7	24.7	8.6
1968	9.3	7.1	8.3	9.1	3.4	5.0	28.9	8.6
1969	9.3	8.1	8.7	9.5	3.9	5.1	32.7	8.4
1970	9.1	8.9	7.5	8.1	3.1	4.8	38.2	8.8
1971	10.1	13.1	8.6	8.9	4.8	5.8	34.6	9.0
1972	9.2	11.3	9.2	10.4	4.4	6.0	36.8	9.4
1973	9.2	10.2	9.0	10.8	4.4	6.6	55.0	9.2
1974	6.6	8.8	9.1	10.0	5.4	7.0	54.2	9.7
1975	8.3	9.5	8.4	9.3	6.7	7.0	35.8	9.9

Source: (29).

Many countries have encouraged the production of feed grains in recent years to support expanded livestock industries. As these countries upgrade diets with more livestock, poultry, and dairy products, the demand for coarse grains will continue to rise. The relative importance of barley as a grain crop in various world regions is shown in table 22. Worldwide barley accounted for about 22 percent of coarse grain production and 10 percent of total grain production. The current surplus problems in wheat should lead to additional shifts from wheat to barley in the future. This is very likely in the European countries where barley is the major coarse grain produced.

Table 22--Relative importance of barley as a grain crop in various world regions, 1975

World region	Production of--				
	Wheat	Rice	Barley	Other grains	Total
	1,000 metric tons				
North America	75.2	5.8	17.9	186.1	285.0
Central America	2.9	2.0	.4	14.7	20.0
South America	11.9	11.0	1.2	32.9	57.0
Africa	8.8	7.7	4.0	45.7	66.2
West Asia	19.3	1.6	6.6	2.6	30.1
South Asia	35.4	96.8	3.7	29.4	165.3
East Asia	39.2	222.2	12.2	84.1	357.7
Oceania	11.9	.4	3.5	2.8	18.6
Eastern Europe	95.4	2.2	49.5	75.5	222.6
Western Europe	48.6	1.7	44.9	37.6	132.8
World total	348.3	351.3	143.9	510.9	1,354.4

Source: (29).

In December 1974, the Economic Research Service published the World Food Situation and Prospects to 1985 (FAER-98) in which aggregate cereal grain projections were made. These projections were based on four sets of alternatives. The alternatives are essentially different assumptions concerning the rate of economic growth and development in the various countries of the world. World cereal grain demand in 1985 was estimated to be between 1,502 and 1,644 million metric tons. World production was estimated at from 1,504 to 1,646 million metric tons, giving a favorable balance of 2 million metric tons. These projections predict a faster growth in coarse grain demand than in wheat or rice demand because of faster growth in feed demand generated by expanded livestock and poultry production. The ERS analysis also suggests that developed centrally planned countries will continue to supply the

developing importing countries with grain as the latter increase their feed grain imports. These projections point out a general upward trend in the demand for livestock products which will generate a substantial increase in demand for coarse grains including barley. For those wanting additional information, the Food and Agriculture Organization has also projected world coarse grain production (18), (19).

World demand for barley as a food grain should decrease as the developing nations develop and improved incomes result in dietary changes. The demand for malt barley will undoubtedly increase as population grows, while the volume of feed barley demanded will depend on relative prices of other feed grains. Therefore, although a world-wide increase in livestock and poultry is projected, the demand for feed barley may not necessarily increase accordingly. The volume of barley may be more related to world food needs, with more profitable and more needed crops grown in its place.

World Trade

World barley trade increased to about three times the 1950 level in the late sixties and early seventies, rising at about the same percentage increase as world production. However, the U.S. role in barley trade did not follow the worldwide pattern. The U.S. share dropped from 40 percent of total world exports in 1959 to less than 10 percent in most of the years since 1966. U.S. exports have generally been unstable, fluctuating from a high of 2.5 million metric tons in 1959/60 to less than half of that amount in recent years.

In 1954/55, world barley and corn exports each accounted for 38 percent of the total coarse grain shipments of 14 million tons. They were followed by sorghum and millets (9 percent each), and rye and oats (8 percent each). By 1963/64, corn exports constituted 63 percent of the 33 million tons of coarse grain exports. Sorghum and millets accounted for 11 percent, and shares of barley, oats, and rye declined to 20, 4, and 2 percent, respectively. Preliminary 1972/73 figures estimate corn exports at 67 percent of the total, followed by barley, 18 percent; sorghum, 11 percent; oats, 2 percent; and rye, 2 percent. The general decline in barley exports relative to corn reflects the strong export demand preference for the latter which has developed in recent years.

The worldwide trade of malt is not great, but it reflects world production and demand for malt liquors. World production of malt liquors has increased at the rate of 5 to 6 percent annually in recent years, and is highly dispersed throughout the world, reflecting the worldwide demand for beer and other distilled liquors and spirits.

Four major exporting countries--Argentina, Australia, Canada, and the United States--accounted for 4.5 billion metric tons, or 50 percent of the 1974/75 world exports (table 23), while 15 major importing countries acquired 86 percent. This trade pattern shifts from year to year depending on changing demand, weather conditions, and production policies, but in general, the same countries are usually active in the world market.

Table 23--World barley trade by major country, 1973 and 1974 1/

Destination 2/	Origin 3/												Total	
	United States		Canada		Australia		Argentina		Total four countries		All other			
	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974
	1,000 metric tons													
Japan	46	85	806	745	410	509	--	--	1,262	1,339	52	--	1,314	1,339
Belgium-Luxembourg	60	--	32	7	7	32	--	--	99	39	1,081	993	1,180	1,032
West Germany	194	15	222	63	14	27	1	--	431	105	940	873	1,371	978
Italy	171	18	515	485	--	--	103	8	789	511	458	308	1,247	819
Poland	256	20	287	356	--	--	1	--	544	376	369	252	913	628
Switzerland	--	--	--	6	--	--	--	--	--	6	557	513	557	519
Netherlands	6	1	21	61	--	--	--	1	27	63	317	396	344	459
Korea, Republic of	344	248	6	--	27	152	--	--	377	400	--	--	377	400
United Kingdom	--	--	70	37	38	15	--	--	108	52	562	346	670	398
United States	--	--	276	316	--	--	--	--	276	316	--	--	276	316
Iran	39	82	56	163	24	26	--	--	119	271	--	1	119	272
Mexico	165	205	--	--	--	--	--	--	165	205	--	4	165	209
Israel	13	--	236	206	--	--	--	--	249	206	2	--	251	206
All other	648	193	383	183	212	225	44	20	1,287	621	1,530	701	2,817	1,322
World total	1,942	867	2,910	2,628	732	986	149	29	5,733	4,510	5,868	4,387	11,601	8,897

1/ Year beginning July 1.
2/ Includes all countries importing 200 metric tons or more in 1974/75.
3/ Exports from France not available for these years. In 1972/73 French exports totaled 3.6 million metric tons compared with 3.7 million metric tons by Canada. In 1972/73 France exported large quantities of barley to the U.S.S.R., West Germany, Belgium-Luxembourg, Hungary, Switzerland, and Poland.

Source: For. Agr. Serv., U.S. Dept. Agr.

Pricing in International Trade

Prices in international trade fluctuate from year to year depending on world grain supplies and other economic conditions. International price relationships between the coarse grains--barley, corn, sorghum, and rye--change continuously and are frequently reversed by changes in the supply-demand relationship of individual feed grains and wheat in importing and exporting countries. Substitution between grains is an important factor. For some uses, especially food and alcoholic beverages, substitution is less than for others. Price relationships among the coarse grains tend to approach their relative feeding values in periods of large supplies of all grains. These relationships, however, may change at times when grains are in extremely short or long supply.

International prices of all grains declined throughout the early fifties because of rising carryover stocks of wheat and coarse grains in the major exporting countries. The sharp rise and subsequent fall of freight rates associated with the Suez crises had some destabilizing effects on prices in the late fifties. During the sixties, international coarse grain prices trended upward, reflecting general inflation, rising production costs, and increased demand.

The general level of barley prices in international markets has been consistently below hard wheat prices. Soft wheat prices, however, have been much nearer barley prices because more soft wheat than hard wheat has been used in livestock feeding. The close relationship between prices of soft wheat and barley was evident in price movements of French soft and U.S. soft-red winter wheats. Since 1950, import barley prices have frequently been higher than the price of French soft wheat and occasionally above U.S. soft-red winter wheat.

International barley prices tend to fluctuate more than corn prices. 9/ At times, they rise by more than 50 percent within a few months. The large international barley price fluctuations provide a contrast to the relatively stable corn prices, and reflect the basic differences in the two market structures. The more stable corn prices reflect the prominence of the United States in the world market. The United States annually accounts for about 50 percent or more of world corn exports. Also, the United States has been the only country maintaining sizeable corn stocks. Under these circumstances, U.S. supplies have had a stabilizing effect on international prices. The United States, Argentina, and France account for nearly 80 percent of the world trade in corn, with "occasional" exporters playing a negligible role. The markets for corn are primarily Japan, the Netherlands, Italy, and the United Kingdom. These countries use corn largely for livestock and poultry feed, and often account for 60 percent of the world trade. They have limited potential for expanding their domestic production, thus creating a relatively stable demand.

9/ Rotterdam grain prices are regularly reported by the For. Agr. Serv. in Foreign Agriculture, and in FAS circulars, World Grain Situation, various issues.

Major exporters in the world barley market, Canada and Australia, account for about 50 percent of the trade, but other countries such as Argentina, the United States, or France may account for a sizeable percentage of the total in any given year. One factor which leads to instability in the world barley market is the erratic demand for high grade malting barley. Western European barley demand, for example, is largely met from domestic production. In years of low production, however, these countries are in the market for large quantities of malting barley.

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Acrospire--The shoot that is formed in the germination process and grows to about the length of the kernel. The part that extends from under the hull is broken off and becomes a feed byproduct along with the rootlet.

Aleurone--The barley kernel is composed of the outer hulls and the seed coat or outer layers surrounding the berry itself. Just under the seed coat are a few layers of very important nitrogen-rich cells comprising the aleurone layer. These cells, when properly activated, are the major foci for the secretion of hydrolytic enzymes into the endosperm to disintegrate the structure of this starch-containing storage material and accomplish what is called "modification."

Channels of trade--A particular direction of flow. For example, the movement of barley from an inland terminal to a maltster is one channel of trade.

Country elevator--These facilities are located in production areas, and serve as the primary outlet for off-farm sales. Country elevators make unofficial determinations of grain grades and weights. They generally take title to the grain they handle, but in some cases may provide the source of handling grain previously contracted to another buyer.

Deferred payment--If farmers already have high incomes for the year, they may want to deliver but not receive payment for barley in the year it is produced. The delayed income is termed a "deferred payment."

Enzyme potential--Barley, when malted, produces two known starch-splitting enzymes, Alpha amylose and Beta amylose, in relatively large amounts. The combination of these two enzymes results in more rapid and complete hydrolysis of starch to dextrins and fermentable sugars. Of the grains, only barley, wheat, and rye have both Alpha and Beta enzyme potential. The potential for transforming starch to fermentable sugars is not the same for all varieties; thus, the careful selection of malt varieties.

Flow--The movement of grain and grain products through the marketing system from one stage to another by some means of transportation, beginning at the farm gate and ending at the final use.

Highgrade--Highgrading is a process whereby low and high quality products are separated. In the barley industry, poorer quality kernels not suited for malting are separated out and sold to feed manufacturers, resulting in a higher quality malting product.

Hull-less barley--A characteristic of some barley varieties whereby the hull detaches itself from the kernel in the harvesting process. The hull does not detach itself from the kernel in most barley varieties.

Inland terminal elevator--A facility located at a point of accumulation and distribution in the movement of grain. An inland terminal elevator procures a large share of its grain from other elevators rather than directly from farmers. Inland terminal elevators are located at interim

points. They have facilities for establishing official grades and weights, and may store grain for others.

Malt--Final malt, ready for shipment, evolves when the kilned malt is cleaned to remove the dried rootlets and give a degree of polishing. Casual observation indicates that the final product varies little in appearance from the original barley, but on close inspection it is seen that the kernels are somewhat larger in size, give evidence of the dried acrospires under the husks, and have husks that do not adhere as tightly to the main body of the kernel.

Midwestern six-row Manchurian--Relatively small-kerneled barleys which are medium-high in protein, vigorous in germination, and produce high enzymatic activities during malting; used for the production of brewer's and distiller's malts.

Naked barley--Refer to hull-less barley.

Near-beer--Beer that has most of the alcohol removed so that the final beer contains less than 0.5 percent alcohol and can be considered a nonalcoholic beverage. This product was widely produced during Prohibition days.

Off-farm sales--Sales of grain by farmers which can be at harvest or any other time. They include sales of grains produced in the past harvest and any stored grain.

Out-of-position--The uneconomical location of a firm or commodity due to changes such as in transportation rates and demand.

Pearled barley--A barley product remaining after the hull, the kernel coating, practically all of the embryo, and part of the outer layers of the starchy endosperm have been removed by a grinding process. One hundred pounds of barley yields approximately 35 pounds of pearled barley.

Photoperiodism--Day-length sensitivity of plants. A critical photoperiod is required for flowering. Fall-planted day-length sensitive plants and winter barleys planted at more southerly latitudes do not head early enough in the North to produce maximum yields. Spring-planted spring barleys grown at latitudes comparable to Montana are typical long-day (short-night) plants. Spring-planted barleys perform as though they were day-length insensitive.

Pipeline stocks--The grain or grain products that are not in storage awaiting a buyer, or in inventory as stored grain. These stocks may be in transit or may be held in working space.

Port terminal elevator--An elevator located along waterways and designed to load out vessels with grain and other products. A port terminal elevator receives most of its grain from subterminal elevators or inland terminals. Port terminals have facilities for establishing official grades and weights.

SIC--Standard Industrial Classification used by the U.S. Bureau of the Census to group like industries. A four digit SIC, like 2085, indicates an individual industry, such as distilled liquors.

Six-rowed barley--The axis of the barley head has nodes throughout its length, alternating from side to side. For six-row barley, three kernels develop at each node, a central kernel and two lateral kernels.

Spent grain--The hulls and other solids remaining in the brewers mash tub. Spent grains are dried and sold as a feed byproduct.

Terminal market--A large concentration of wholesale grain handlers, commission merchants, and grain brokers which may be complemented by a Grain Exchange or Board of Trade, which in turn, houses an association organized for the purpose of providing a place where buyers and sellers may conduct trading in both the cash and futures market.

Two-rowed barley--The axis of the barley head has nodes throughout its length, alternating from side to side. For two-row barley, only the central kernel develops, both laterals being sterile. (Compare with six-row barley.)

Vernalization--The stimulation of growth and maturity of a plant by passing through a dormant period (winter). A true winter barley, for example, will not mature if planted in the spring. (See photoperiodism.)

Western six-row--Brewing barleys grown primarily in California. Large kernels, thick hulls, medium protein content, rather slow physical and chemical modification, and low enzymatic activities after malting are characteristics of this type of barley. These are used for brewing in the West Coast and Rocky Mountain areas, or for blending with midwestern type malts for brewing.

Western two-row--Grown primarily in the Northwest and intermountain areas of the United States. They have medium sized, uniform, plump kernels with a thin hull. They are generally low in protein and high in starch with vigorous germination and intermediate enzymatic activity during malting. It is used by the brewing industry both by itself and for blending with midwestern six-row barley.

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